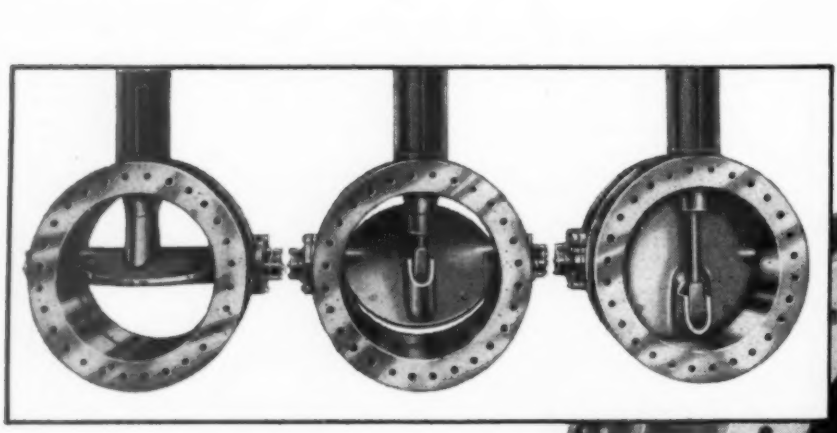
WATER & SEWAGE WORKS

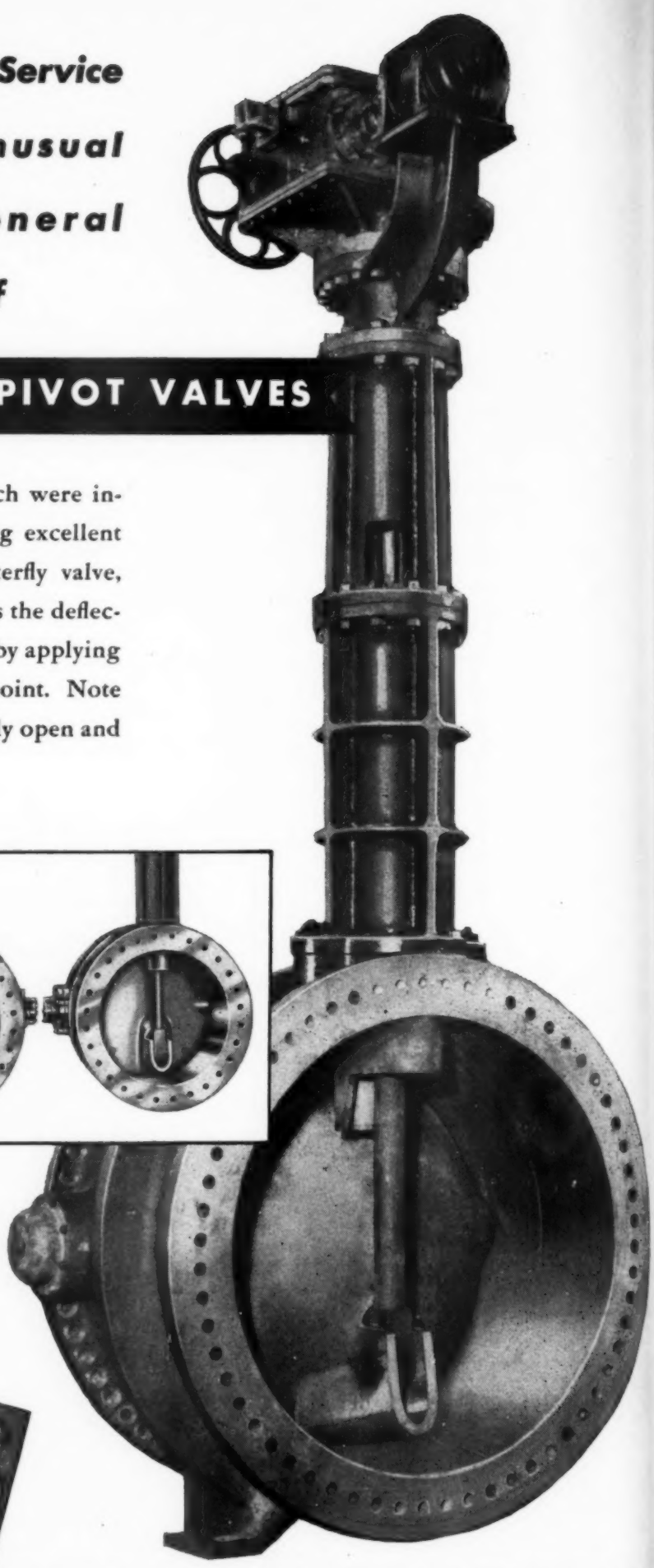
ABP ABC

A Quarter-Century of Service Has Proved the Unusual Strength and General Reliability of

DOW DISC-ARM PIVOT VALVES

The first valves of this design, which were installed 25 years ago, are still giving excellent service. An improved type of butterfly valve, the Dow Disc-Arm Pivot Valve takes the deflection out of the lower half of the disc by applying the operating force to the proper point. Note below how disc is held in open, partly open and closed positions.





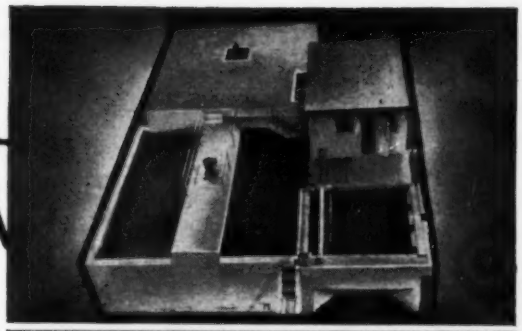
The Chapman Valve Manufacturing Company

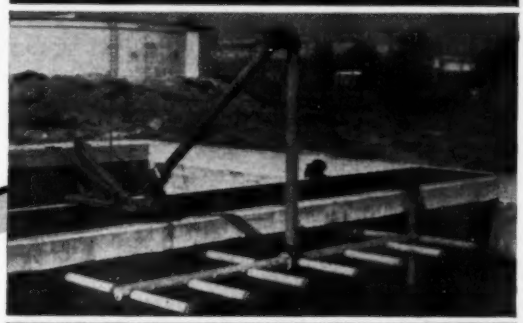
INDIAN ORCHARD, MASS.

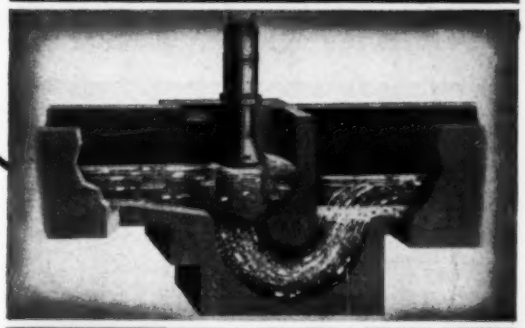
Complete engineering data and recommendations are contained in Bulletin No. 40. Write for a copy.

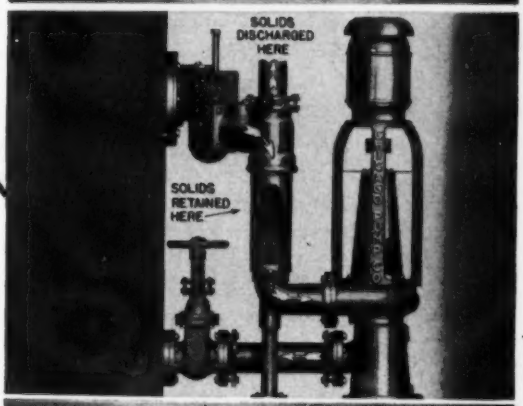
WATER AND SEWAGE WORKS, September, 1946, Volume 93, Number 9. Published monthly by Gillette Publishing Co., 22 West Maple St., Chicago 10, Ill. Per copy, 25c. Subscription rate, United States, $2.00 per year; Canada, $2.00 per year; Foreign, $3.00 per year. Entered as Second Class Matter, March 12, 1946, at the Post Office at Chicago, Ill., under act of March 3, 1879.

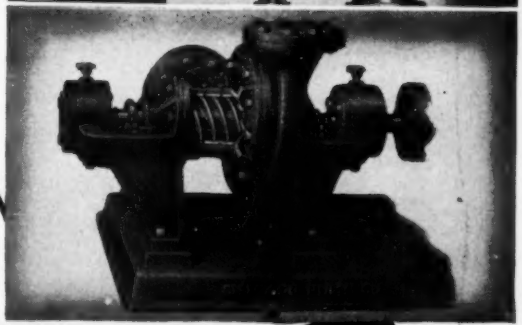
NOTABLE, EXCLUSIVE CONTRIBUTIONS TO SEWAGE TREATMENT











"PACKAGE" PLANTS give effective, low-cost nuisance-free complete sewage treatment to small communities, housing projects, institutions, airports and industrial plants. Operation is simple, due to exclusive automatic features. Over 100 in successful operation. Ask for Bulletin 128-K1.

WIDE BAND AIR DIFFUSION SYSTEM WITH SWING DIFFUSERS gives uninterrupted flexible aeration to meet variable operating conditions. Diffuser tubes can be raised to tank walk for maintenance and regulation of air supply without dewatering the aeration tank. Over 100 installations since 1936. Ask for Bulletin 175.

COMMINUTORS automatically screen and cut sewage solids under water. They eliminate screenings handling and disposal, the worst nuisance in sewage plants. They also prevent pump clogging when installed ahead of lift station pumps. Over 1,200 installed since 1933. Ask for Bulletin 185.

FLUSH-KLEEN CLOG-PROOF SEWAGE PUMPS are the most reliable pumps made for sewage lift station service. They cannot clog, because sewage solids do not pass through the pump impellers. Over 3,000 installed since 1924. Ask for Bulletin 122.

SCRU-PELLER SLUDGE PUMP is a screw-feed centrifugal pump with multiple shearing actions all the way through the pump. Over 1,000 installed. Ask for Bulletin 190.

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

2349 WOLFRAM STREET **CHICAGO 18, ILLINOIS**

Flush Kleen, Scru-Peller, Plunger, Horizontal and Vertical Non-Clogs, Water Seal Pumping Units, Samplers.

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

Watch for the engineering advantages of this specialized equipment appearing in succeeding issues of this magazine

Parts and Accessories Stand up in Service when made of Everdur Metal

EVERDUR* Copper-Silicon Alloys, developed and produced by The American Brass Company, are exceptionally tough, strong and resistant to corrosion. Made in compositions suitable for hot or cold working, machining or casting, and in practically all commercial shapes, they lend themselves to economical production of items such as those illustrated.

Other items for which Everdur is widely used include coarse and fine screens, float chambers, swing gates, coarse bar rack aprons, effluent weirs and scum weirs, troughs, screen hoppers, baskets, valve springs, valve stems, spillway fittings and many others.

Because of the long, economical service rendered by Everdur, these durable alloys have become preferred construction materials for water works and sewage treatment equipment. For further information, ask for Publications E-11 and E-6. 46214

*Reg. U. S. Pat. Off.

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General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

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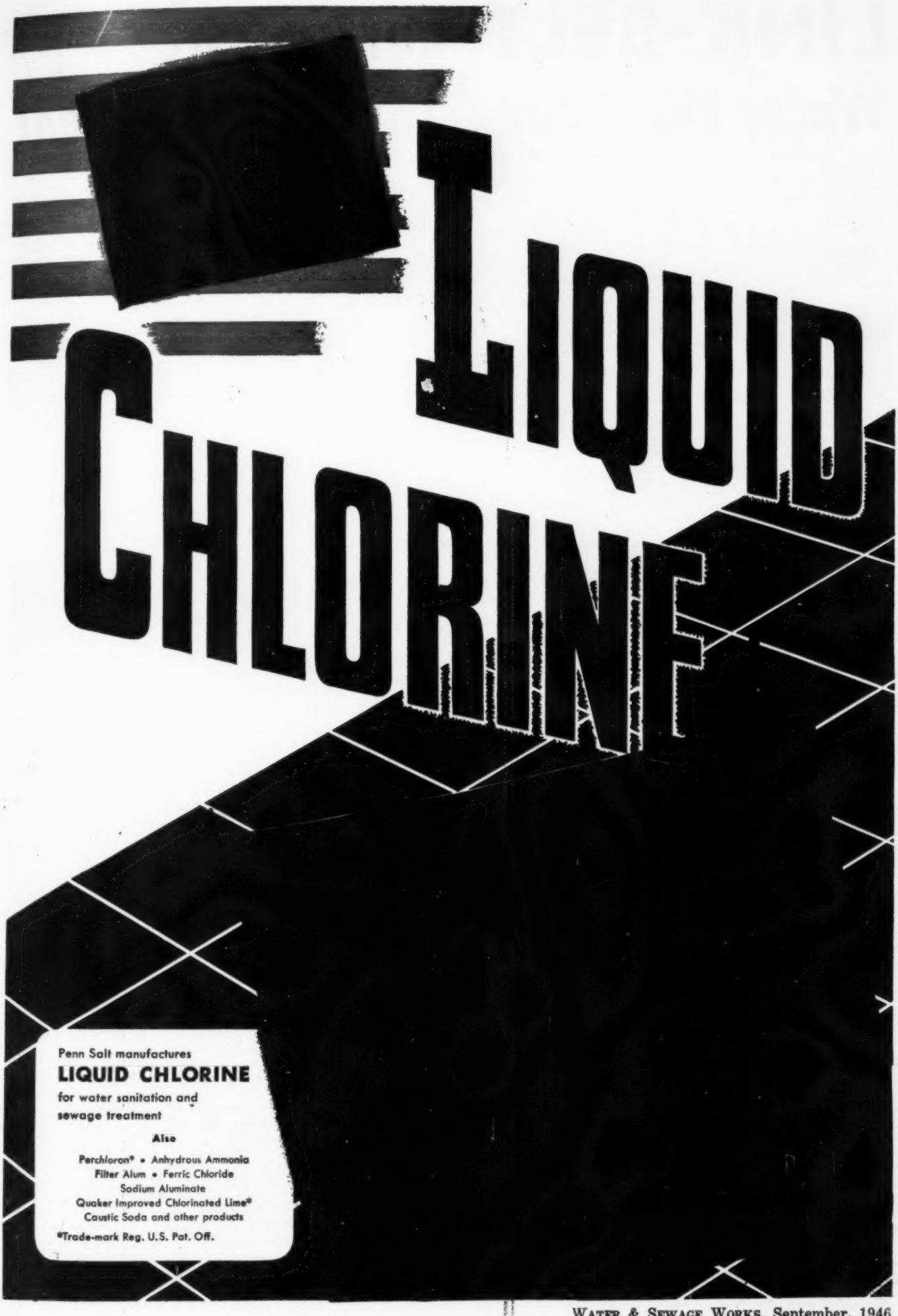
LIQUID
CHLORINE
Penn Salt manufactures
LIQUID CHLORINE
for water sanitation and
sewage treatment
Also
Perchloron* • Anhydrous Ammonia
Filter Alum • Ferric Chloride
Sodium Aluminate
Quaker Improved Chlorinated Lime*
Caustic Soda and other products
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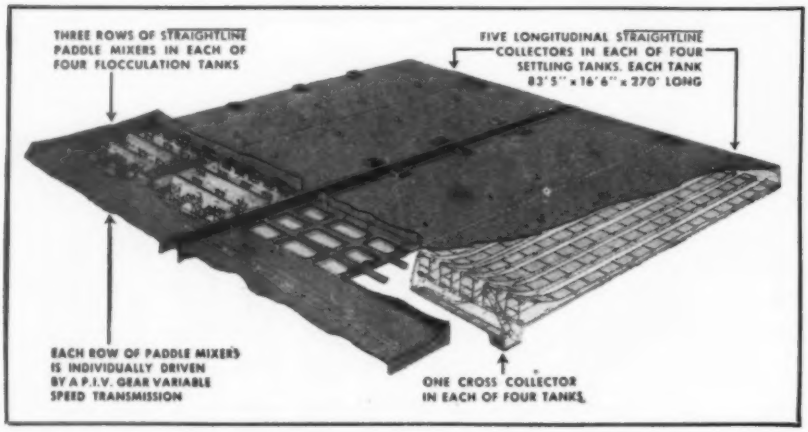
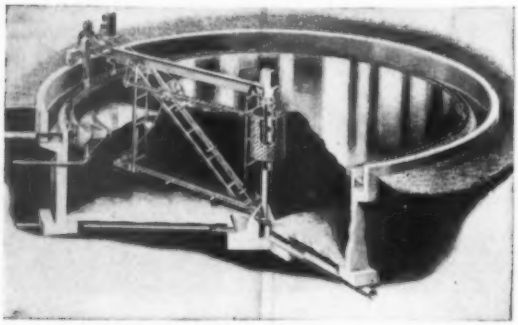
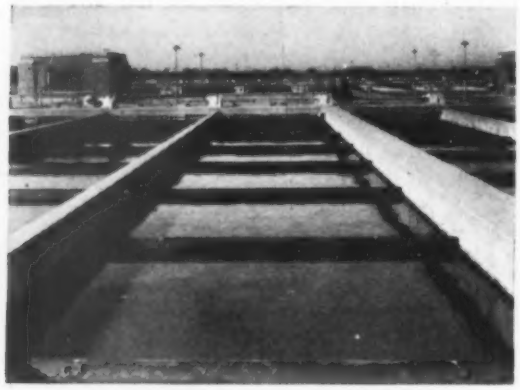
LINK-BELT Equipment *in* *Water Works and Sewage Treatment*


THREE ROWS OF STRAIGHTLINE PADDLE MIXERS IN EACH OF FOUR FLOCCULATION TANKS
FIVE LONGITUDINAL STRAIGHTLINE COLLECTORS IN EACH OF FOUR SETTLING TANKS. EACH TANK 83' 5" x 16' 6" x 270' LONG
EACH ROW OF PADDLE MIXERS IS INDIVIDUALLY DRIVEN BY A P.I.V. GEAR VARIABLE SPEED TRANSMISSION
ONE CROSS COLLECTOR IN EACH OF FOUR TANKS

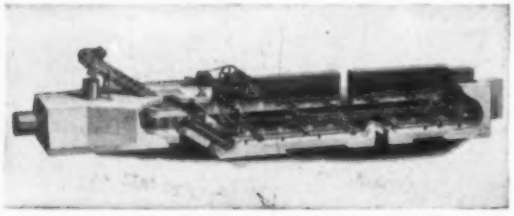
Link-Belt Straightline collectors and paddle mixers are used exclusively in the settling and flocculation tanks of the Lake Erie Water Project, City of Toledo Filter Plant. Each of the four tanks, which are 85' 5" wide by 16' 6" deep by 270' long, employs five longitudinal collectors and one cross collector — a total of 24 collectors being used. Each collector has an individual motor and drive. They are completely covered, as illustrated in the photograph to the left.



Circuline Sludge Collectors for the positive removal of sludge from round tanks. Send for Book 1982.



Straightline Sludge Collectors for the positive removal of sludge from rectangular tanks. Send for Book 1742.



Straightline Grit Collector and Washer. Effectively collects, washes and removes settled grit and separates it from putrescible organic matter. Send for Folder 1942.

CONSULTING engineers, public officials and operators of sewage treatment and water purification plants, have long known that Link-Belt screens, sludge collectors, mixing, aeration, conveying and driving machinery, are durable, dependable and economical. All Link-Belt equipment is engineered and manufactured in our own plants. It is built to last and to operate at maximum efficiency. Send for catalogs.

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8.
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10,475

Tritor Screen. A combination screen and grit chamber for medium and small size plants. Folder 1587.

Mechanically-cleaned Bar Screens for removing the larger floating solids. Send for Book 1587.

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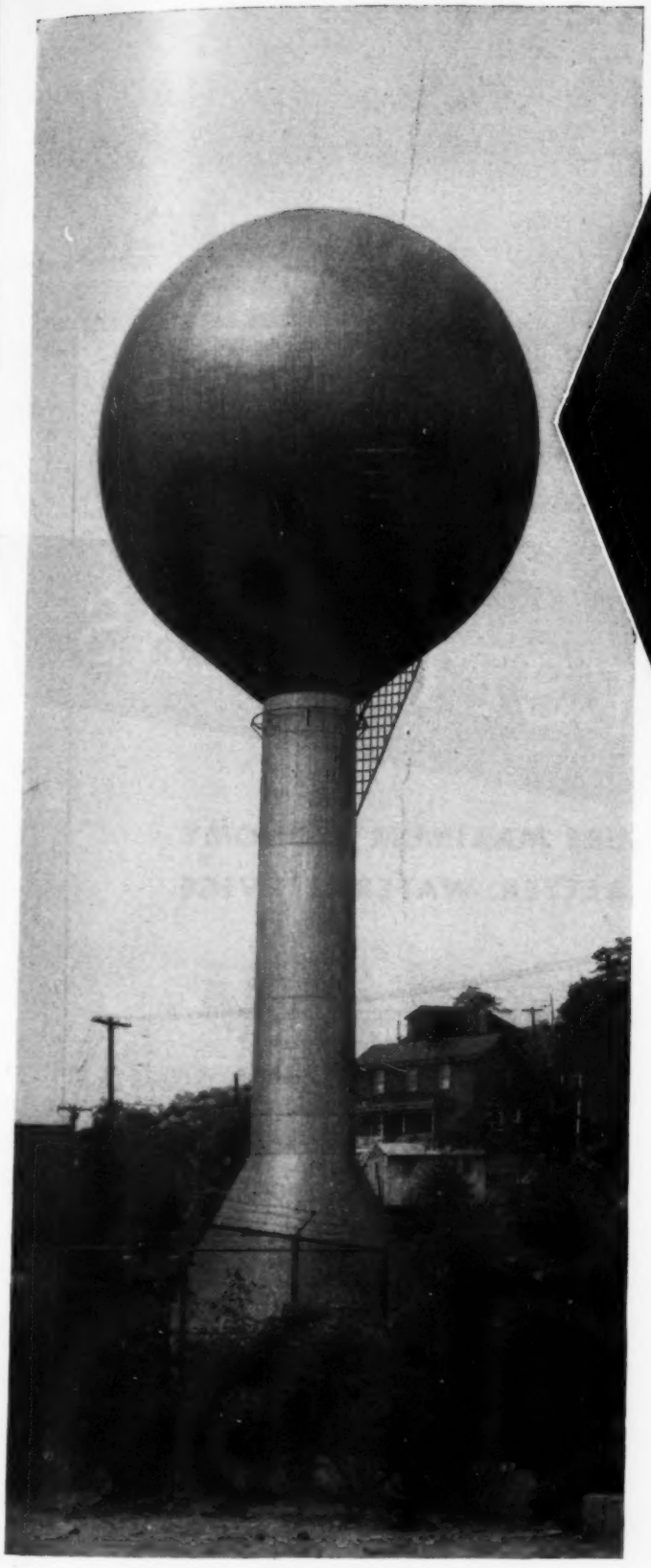
SCREENS · COLLECTORS · MIXERS · AERATORS

SEE OUR EXHIBIT — Federation of Sewage Works Ass'ns — Toronto, Oct. 7-9



IT'S A *Horton* WATERSPHERE*

...50,000-gal. streamlined elevated tank providing wash-water for filters at new softening plant.

THE Woodlawn Water Company installed the Watersphere shown at the left to provide washwater for its filter plant at Aliquippa, Pa. The water company serves 4,833 customers who use an average of 1,782,500 gpd. The water taken from a well field has a hardness of 300 ppm and a pH of 7.3. It is pumped to the new softening plant which contains eight gravity rapid-sand filters, six of which are green sand zeolite units and two silica sand. The filter beds are washed every 5 hours. The Watersphere is filled from one well between washings. The only treatment given the washwater is chlorination.

ADVANTAGES OF USING ELEVATED WATERSPHERES FOR WASHWATER

Before the Watersphere was installed, finished water was used for washing filters. It was provided by two 3,800-gpm pumps driven by two 60-hp. motors. The Watersphere has made an appreciable savings in power since it is filled between washings with a 500 gpm turbine-type pump driven by a 300 hp motor. It also eliminates the cost of treating the washwater and, in effect, increases the output of the plant 300,000 gpd since the finished water formerly used for filter washing is now used in the distribution system.

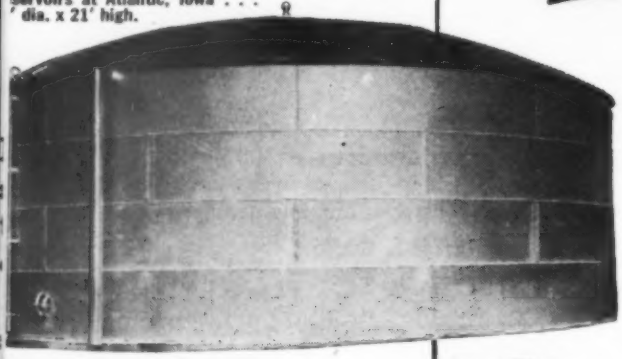
**Horton Waterspheres are built by Chicago Bridge & Iron Company, designers and fabricators of Horton all-welded steel elevated tanks for municipal distribution systems.*

CHICAGO BRIDGE & IRON COMPANY

Chicago 4.....2198 McCormick Bldg.
New York 6.....3390-165 Broadway Bldg.
Cleveland 15.....2262 Guildhall Bldg.
Los Angeles 14.....1455 Wm. Fox Bldg.
Birmingham 1.....1586 North 50th Street
Atlanta 3.....2181 Healey Bldg.
Plants in Birmingham, Chicago and Greenville, Pa.

Tulsa 3.....1646 Hunt Bldg.
Houston 1.....5615 Clinton Drive
Philadelphia 3.....1644-1700 Walnut Street Bldg.
Washington 4.....703 Atlantic Bldg.
San Francisco 11.....1283-22 Battery St. Bldg.
Detroit 26.....1551 Lafayette Bldg.
In Canada: Horton Steel Works, Limited, Fort Erie, Ont.

WHERE NATURAL ELEVATIONS ARE AVAILABLE . . .



...e 100,000-gallon capacity P-DM ...servoirs at Atlantic, Iowa . . . ...' dia. x 21' high.

...ove—1,000,000-gallon P-DM ...servoir at Bottineau, N. D., ...' dia. x 24' high.

Below—two 3,000,000-gallon P-DM Reservoirs at Berryville, Va., . . . 144' dia. x 25' high.

PITTSBURGH-DES MOINES Steel RESERVOIRS

ASSURE MAXIMUM ECONOMY IN BETTER WATER SERVICE

The permanence of steel, its strength, lower cost and ease of erection, apply to particular advantage in the reservoir storage of water. Pittsburgh-Des Moines Steel Reservoirs are impervious to the effects of climate, seasonal changes and weather—cannot crack, spall or deteriorate. With simple maintenance and periodic painting they are good for a lifetime—a truly sound investment! *Let us consult on your needs.*

PITTSBURGH · DES MOINES STEEL CO.

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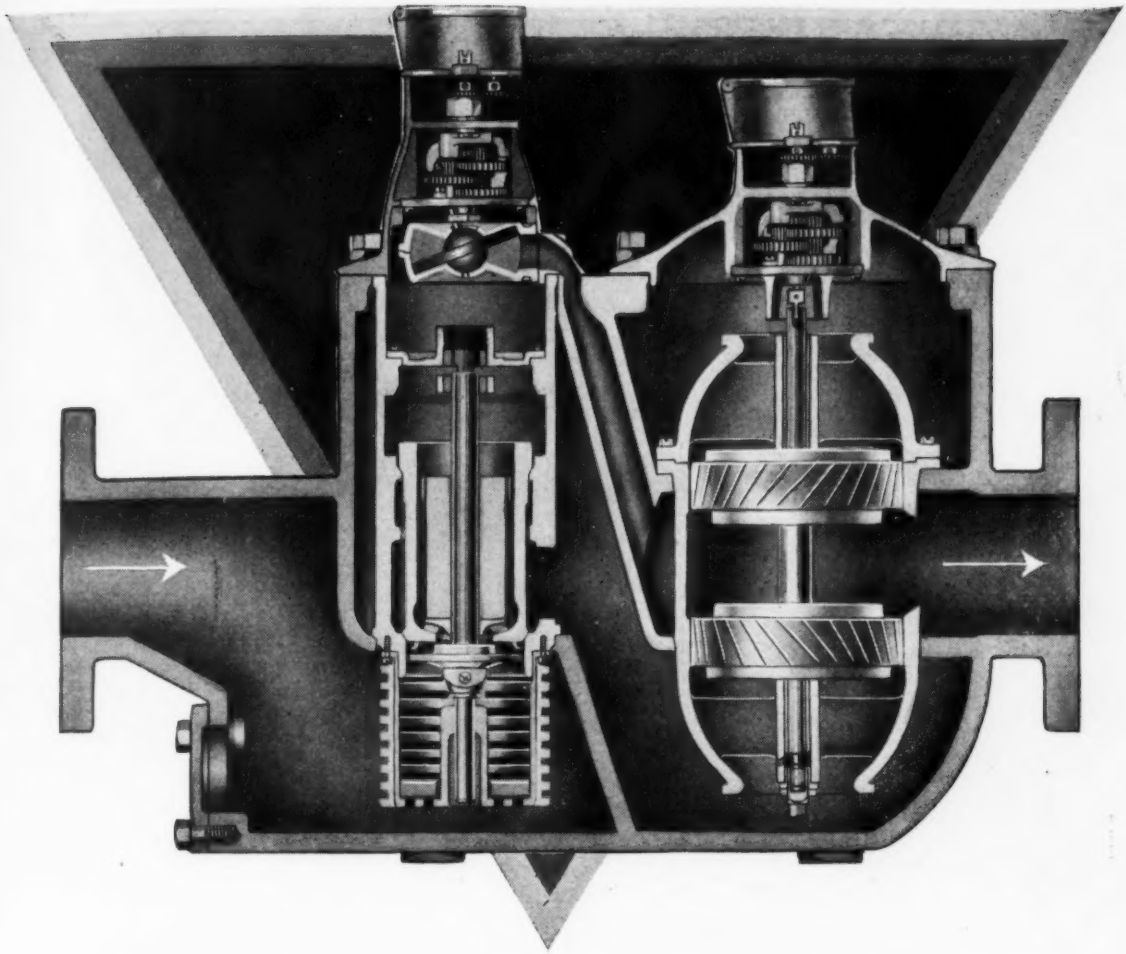
NEW YORK, ROOM 915, 270 BROADWAY · CHICAGO, 1216 FIRST NATIONAL BANK BUILDING

DALLAS, 1217 PRAETORIAN BUILDING · SAN FRANCISCO, 619 RIALTO BUILDING



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BADGER COMPOUND METERS HAVE NO EQUAL

The installation of a Badger Compound Meter is positive assurance that maximum revenue will be secured. Years of service have proven the soundness of the engineering principles incorporated into Badger Compound Meters. Let a Badger engineer assist you with your large consumer problems. It will pay dividends.

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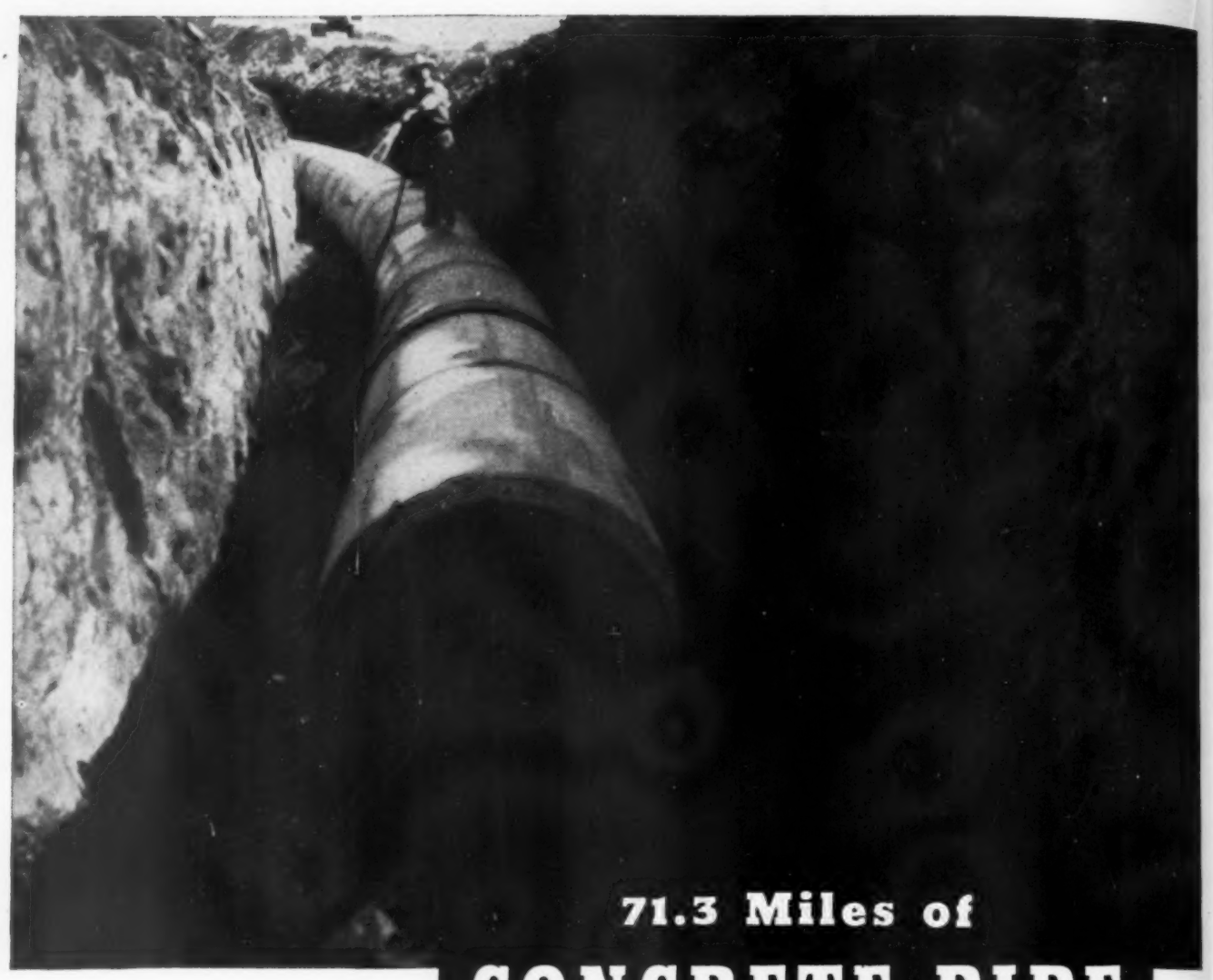


71.3 Miles of
CONCRETE PIPE
in San Diego Aqueduct

54-in. spiral reinforced concrete high pressure pipe being installed for San Diego Aqueduct in a section near Winchester, Calif.

RAPID construction without use of critically scarce materials was a primary requirement for the 71.3 mile gravity flow aqueduct now being built to avert a water shortage in San Diego, Calif.

Reinforced concrete pipe in sizes ranging from 48-in. to 96-in. I.D. are being used to meet this requirement.

The durability, efficiency and economy of concrete pipe for water lines, land drainage, irrigation and sanitary sewers has been demonstrated for more than fifty years.

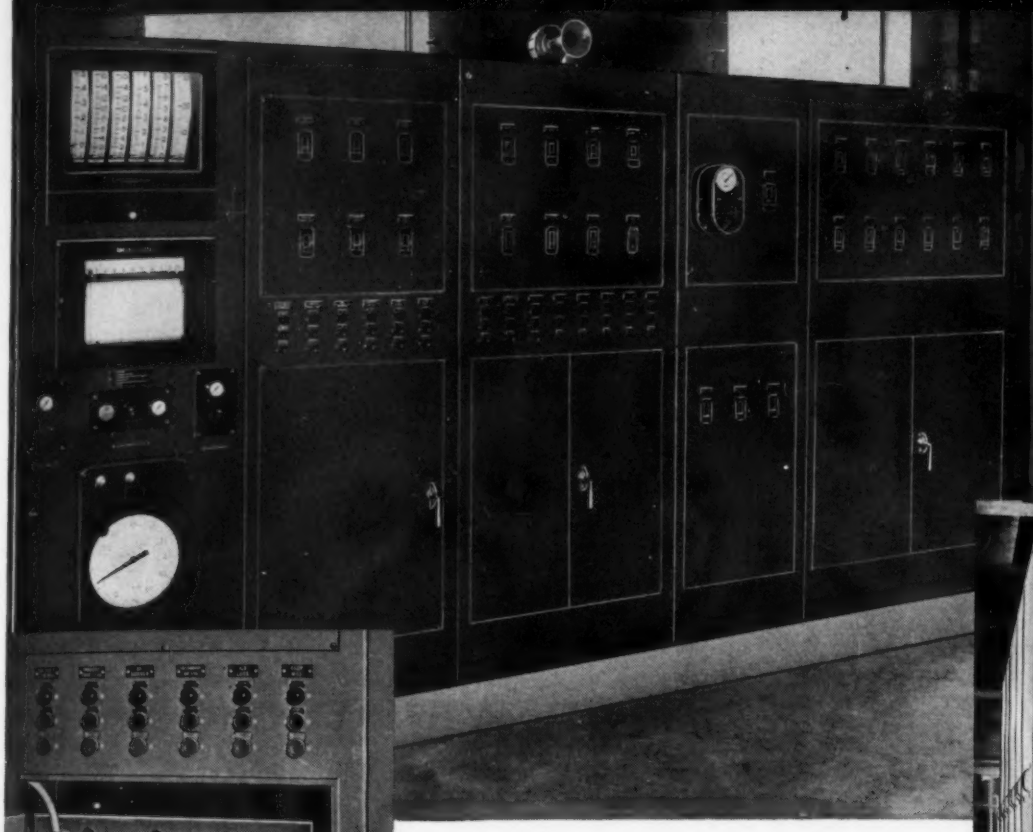
Technical information on concrete pipe will be furnished without obligation by this Association or any of its members. (List of members on request.)

Construction of this 71.3 mile San Diego Aqueduct is under the supervision of Capt. Alden K. Fegg, Public Works Officer, 11th Naval District. He is assisted by Comdr. R. D. Thorsen, Resident Officer in charge of construction; O. H. Lillard, office engineer; Lt. Comdr. F. M. Hines, northern division, Lt. D. A. Gray, southern division, resident officers. R. B. Ward, Senior Engineer of the U. S. Bureau of Reclamation is consultant on the site.

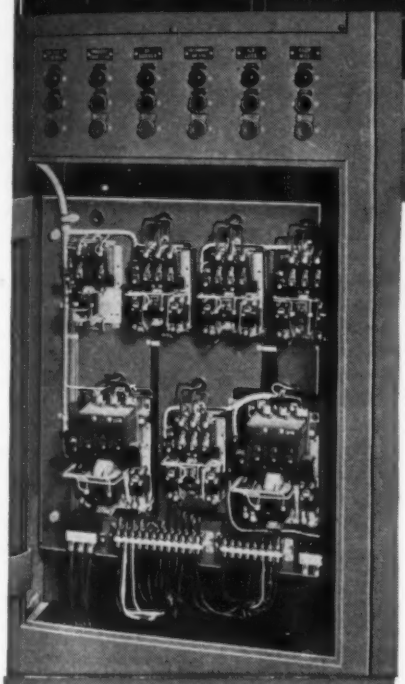
AMERICAN CONCRETE PIPE ASSOCIATION

228 NORTH LA SALLE STREET — CHICAGO 1; ILLINOIS

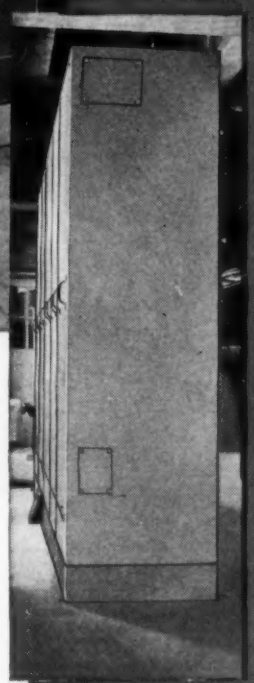
Neat, Compact, Efficient - "3C" CUBICLE CONTROL CENTER for 21 Motors at SEWAGE TREATMENT PLANT



Cubicle at extreme left contains instrument panel; next two, the "3C" electrical control for pulverizing equipment; the fourth, Incoming Power and Lighting lines; fifth, control for filter equipment. 21 motors are controlled by "3C" apparatus in these cubicles.



Open view of second cubicle—containing motor controls for pulverizing machinery. Note how neatly and compactly the "3C" control apparatus is installed, and how accessible for inspection through wide opening door.



End and rear view of cubicles, showing removable back plates, for easy access to wiring, and panel openings at end, which, with identical location on both sides of each cubicle, permit passage of continuous bus bar and control wires.

● Standardization of dimensions makes it possible to assemble any number of Clark Control Cubicles in a neat, symmetrical, "dead-front" Cubicle Control Center—with provisions for adding identical Cubicles later. The control center illustrated was installed recently at a Wisconsin sewage treatment plant which dries the sludge and pulverizes it for sale as fertilizer. "3C" controls help this plant realize considerable revenue from this source.

Our District Offices or Agencies will gladly work with you on your electrical control problems. Write for fully descriptive "3C" Bulletin 9900.

THE CLARK CONTROLLER CO.

1146 EAST 152nd ST., CLEVELAND 10, OHIO • EVERYTHING UNDER CONTROL

An aerial gravity line was indicated as the best means of transporting sewage across this river and into the main trunk sewer. And the engineers selected ARMCO Asbestos-Bonded Pipe for these important reasons . . .

This sturdy corrugated pipe has ample beam strength for aerial suspension. Corrugated coupling bands join long sections — assure a tight joint as strong as the pipe itself. There are fewer joints to connect and, thanks to the light weight of Armco Pipe, even the longest lengths are easy to handle and install. Temperature changes are no problem because Armco Pipe absorbs expansion and contraction without special fittings.

For severely corrosive conditions, a full bituminous coating is tightly bonded to the base metal. Erosion is checked by a thick bituminous pavement that makes the bottom last as long as the top.

Underground, as well as in the air, you will find that ARMCO Asbestos-Bonded Pipe can solve many of your most vexing sewer problems. It withstands destructive vibration under highways and railroads, spans unstable or wet foundations, and can be placed in the deepest trenches. Where necessary this time-proved pipe can be jacked under busy streets without disturbing pavement or traffic. Write today for the Armco Sewer Book. Armco Drainage & Metal Products, Inc., and Associated Companies, 1375 Curtis Street, Middletown, Ohio.

★ ★ ★

Supported by cables and brackets attached to a railroad bridge, ARMCO Asbestos-Bonded Pipe provides safe passage for sanitary sewage. The span is 1700 feet long and 100 feet above the river. Installation time was only 14 days.

ARMCO

ASBESTOS-BONDED

Armco Sewer Pipe

AMERICAN WELL WORKS ENTERS

New Period of Growth

TO MEET UNPRECEDENTED DEMAND FOR MODERN WATER, SEWAGE, AND INDUSTRIAL WASTE TREATMENT

Within the past year, we have strengthened our engineering staff, modernized our plant facilities, and created additional manufacturing capacity to increase production four to five times. Our staff of Sanitary Engineers is available for recommendations on the type of treatment and equipment best suited to your needs.

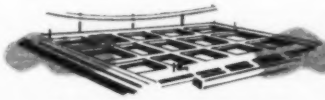
I. G. Grawoig, President

Water Treatment

Installation-tested equipment for complete municipal and industrial systems or individual units . . . Flocsettler, Ferrofilter (for iron and carbon dioxide removal), Mixing equipment (Downflo Flocculation unit, Recarb unit, Downdraft Aerator, and Rapid Mix Turbine unit), Zeolite Softener, Vertical Pressure Filter, Contact Aerator Backwashable, and sludge removal equipment for sedimentation basins.

Sewage Treatment

An inclusive line of equipment for all types and capacities of sewage plants . . . screenings and grit removal, grease flotation and skimming, sludge removal, distribution, filtering, and aerating equipment. Also complete trickling filter, activated sludge, and bio-activation plants. Designed by Sanitary experts, they are the product of close collaboration in the equipment engineering of sewage plants throughout the world.



Industrial Wastes

Since industrial waste treatment methods coincide with those practiced in sewage disposal, our sewage equipment has found wide application in the handling of industrial wastes. Our Sanitary staff is exceptionally well qualified to prescribe methods and equipment for waste treatment in the process industries.

Pumps

As pioneers in the invention and manufacture of deep well, clear liquid transfer, and sewage pumps, American Well Works has thousands of installations throughout the world filling exacting assignments over long periods. Detailed information furnished on all types and capacities of deep well turbines, double-suction, single and two-stage centrifugal, mixed and axial flow, sludge, and sewage pumps.

Research and Engineering

American Well Works maintains a staff of Sanitary engineers for research and to make recommendations on the type of treatment best suited to your water or sewage problem. These engineers are also well qualified to make concrete recommendations on the equipment engineering phases of the work to your consulting engineer.

AMERICAN WELL WORKS

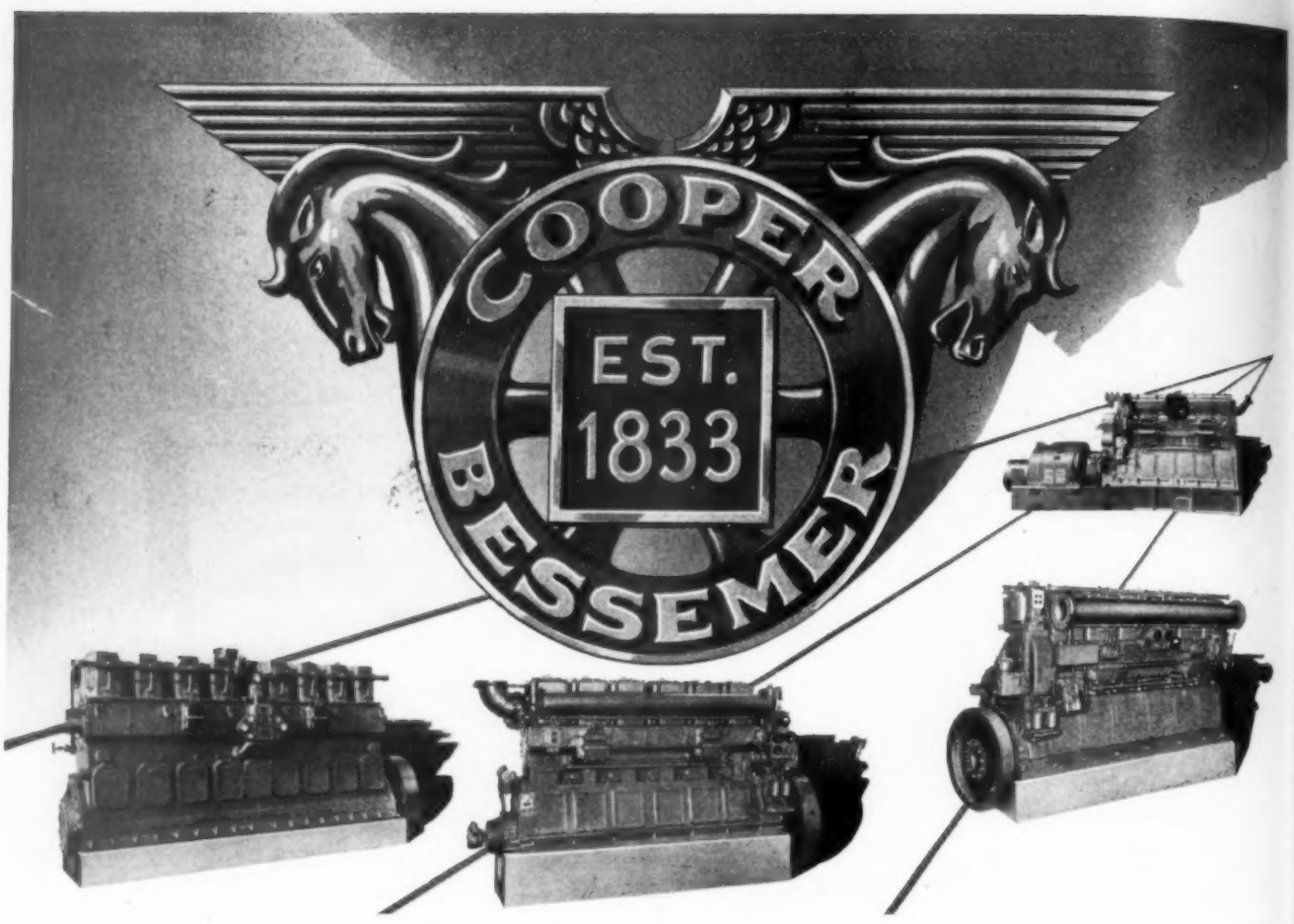
102 North Broadway
AURORA, ILLINOIS

Pumping, Sewage Treatment, and Water Purification Equipment
RESEARCH • ENGINEERING • MANUFACTURING

Offices: Chicago • New York • Cleveland • Cincinnati • Kansas City • Sales Representatives throughout the World

SEND FOR HELPFUL TECHNICAL BULLETINS

Cover all phases of Pumping, Sewage, Water, and Industrial Waste Treatment methods, and fully describe and illustrate required equipment. Send for the particular bulletins you desire.



Sign of Diesel Performance at its Best

THE emblem you see above appears on every Cooper-Bessemer Diesel, symbolizing 113 years of fine engine building. It has present and future significance as well. It means engines today that are better than ever . . . engines tomorrow that are still better than today's. For at Cooper-Bessemer, continuous progress is a century-old habit. This habit pays off to power users . . . pays off in Diesel stamina, efficiency, and all-around performance at its very best!

Cooper-Bessemer diesels range from 100 to 2000 horsepower, supercharged and atmospheric, for all marine, locomotive and stationary services. Get in touch with the nearest Cooper-Bessemer office for specific information.

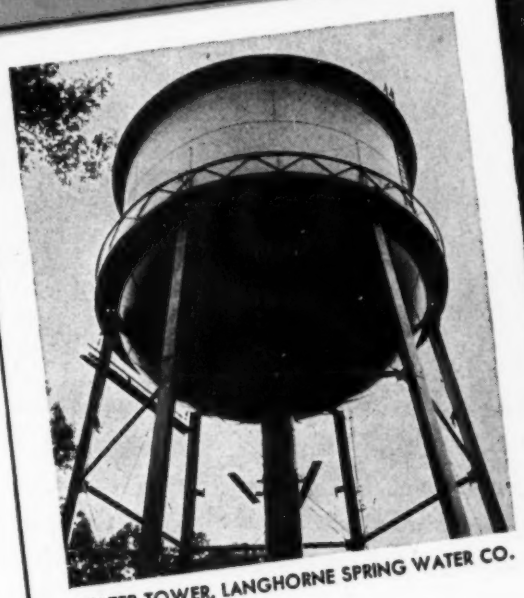
The
Cooper-Bessemer
Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington Tulsa Dallas Seattle
St. Louis Houston Los Angeles Shreveport
Calmes Engineering Company, New Orleans, La.

"I Wouldn't Be Without HTH"

says O. F. Stompler, superintendent of the Langhorne Spring Water Company, Langhorne, Pa.



WATER TOWER, LANGHORNE SPRING WATER CO.

"I wouldn't be without HTH" he repeated. "I always keep a supply on hand for an emergency. HTH not only purifies the water—it actually improves the taste. And the Mathieson Company gives fine service."

Thanks, Mr. Stompler. Your choice of HTH for regular and special chlorination is also the choice of progressive water works officials everywhere.

And we know Mr. Stompler will agree with us when we urge every water works man to write for a free copy of Mathieson's "Hypo-Chlorination of Water". This 80-page illustrated booklet covers all phases of standard sanitation practice including how to use Sanitation HTH in emergencies . . . control of algae . . . sterilizing new mains . . . treatment of filters. Always specify Sanitation HTH—if your regular supplier doesn't have it on hand write directly to:

THE MATHIESON ALKALI WORKS (INC.)
60 East 42nd Street, New York 17, N. Y.

Sanitation HTH is available in cases of nine 5-lb. cans and in 100-lb. drums.

Mathieson
SANITATION HTH

Sanitation HTH...Liquid Chlorine...Chlorine Dioxide PH-Plus (Fused Alkali)...Caustic Soda...Soda Ash...Bi-Carbonate of Soda...Ammonia, Anhydrous & Aqua Dry Ice . . . Carbonic Gas . . . Synthetic Salt Cake Sodium Chlorite Products . . . Sodium Methylate

Flexible Service trucks complete with experienced crews and special Flexible-developed tools are strategically located in all sections of the U.S.A. to give pipe cleaning service quickly.

ONCE UPON A TIME a city thought their underground pipes couldn't be as bad as this until we cut this sample from their lines. Yet many cities are paying the high cost of pumping through lines like this where the C-Value is one-third the original and where friction loss is better than 50%.

New building activity increases the need for water. Will your city be ready? *Clean your old lines first* before you add new and larger water mains. Any degree of tuberculation in a pipe line penalizes your business with higher pumping costs, higher water bills, higher insurance rates, lower pumping capacity and lower customer convenience.

Write or wire today and have Flexible estimate the cost of a thorough pipe cleaning job. Flexible Service trucks with complete crews and tools are strategically located to serve you.

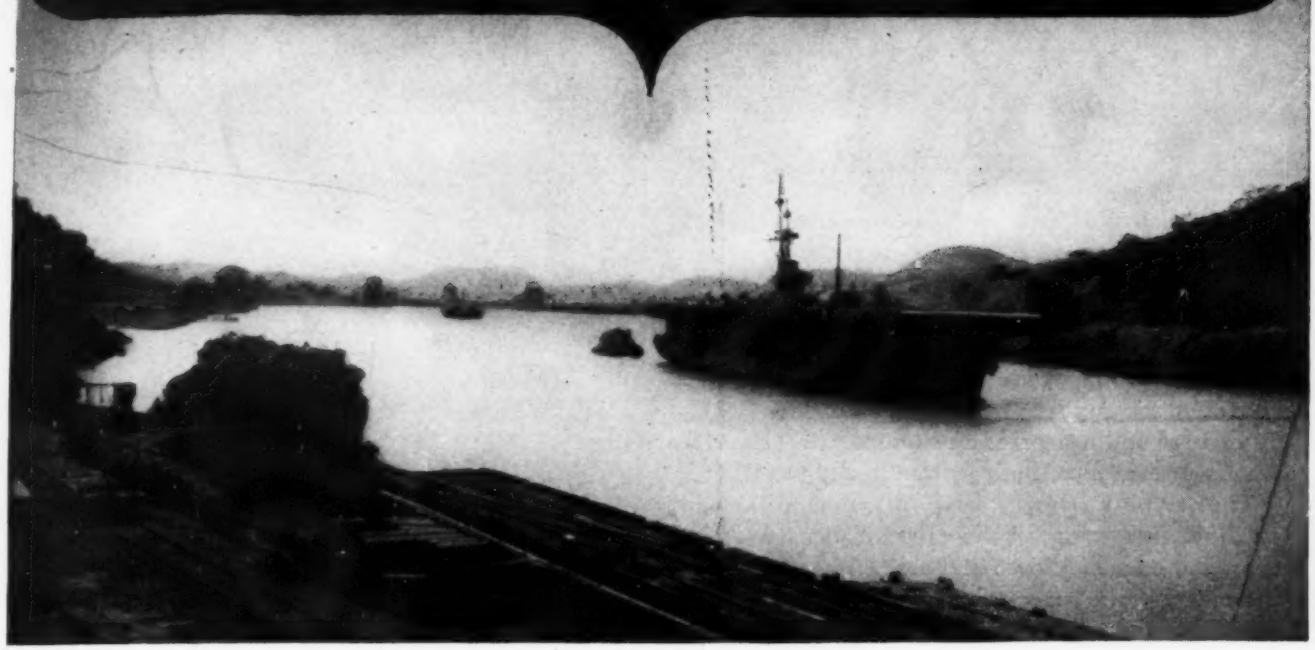
855 Board of Trade Bldg., Chicago 4, Ill.
228 W. Broad St., Columbus 8, Ohio
1624 Marmon Place, Minneapolis 3, Minn.
P. O. Box 165, Atlanta.
P. O. Box 447, Lancaster, Texas
41 Greenway St. Hamden, Conn.
147 Hillside Ter., Irvington, N. J.
P. O. Box 694, Pittsburgh.
401 Broadway, New York 13.
29 Cardan Ave., Roslindale 31, Mass.

FLEXIBLE WILL CLEAN ANY PIPE FROM 2 TO 72 INCHES

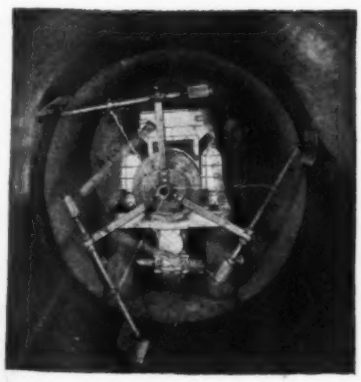
Flexible UNDERGROUND PIPE CLEANING CO.

9059 VENICE BOULEVARD • LOS ANGELES • CALIF.

CENTRILINES



. . . **CENTRILINE** has recently reconditioned for the Government, the 58,000 feet of 30 and 36 inch cast-iron pipe line from Gamboa Pumping Station to Miraflores, Panama Canal Zone. The increased carrying capacity will now be permanently maintained by the thin, dense, smooth cement mortar lining centrifugally applied—a reliable guarantee against future tuberculation, underlying deterioration of metal and increased pumping costs.



The Centriline process is a rapid, economical method of reconditioning pipe lines 30" and larger. After cleaning, a thoroughly premixed cement mortar lining of desired thickness is applied centrifugally without rebound. This dense quality product is mechanically trowelled to a smooth finish providing maximum carrying capacity which is permanently sustained. This work is performed underground, in place.

CENTRILINE CORPORATION

148 CEDAR STREET • NEW YORK 6, N. Y.

Restores and Protects Pipe-Line Carrying Capacity

Here's how

TO GET EFFECTIVE, CENTRAL, *visual* CONTROL FOR WATERWORKS..

Use the rich Westinghouse background in waterworks engineering, as did the half-billion gallon system of the Toledo Lake Erie system.

Keynotes of the control of the system are two Westinghouse control desks shown on the opposite page... one each at the high and low pressure stations. They show the entire waterworks system, both hydraulic and electric.

The sloping panels have illuminated channels and symbols, indicating all the valves, sluices and pumps. Because the opened, closed and other operating positions are illuminated, the operator has a complete, quick, visual picture of the water flow through the entire system at any given instant.

You get the best with Westinghouse control assemblies, because you can use any or all of six standard, time-tested Westinghouse basic elements to gain quick, efficient control concentration: incoming primary voltage switching equipment . . . ASL air-cooled transformer . . . feeder branch circuit protection . . . ASL step-down transformer . . . low-voltage switchgear . . . and control centers.

You get even more than top-notch equipment, for the vast facilities of the Westinghouse organization—including 34 Maintenance and Repair Plants throughout the country—give you the specialized engineering service you need in waterworks electrification. Call your nearest Westinghouse office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

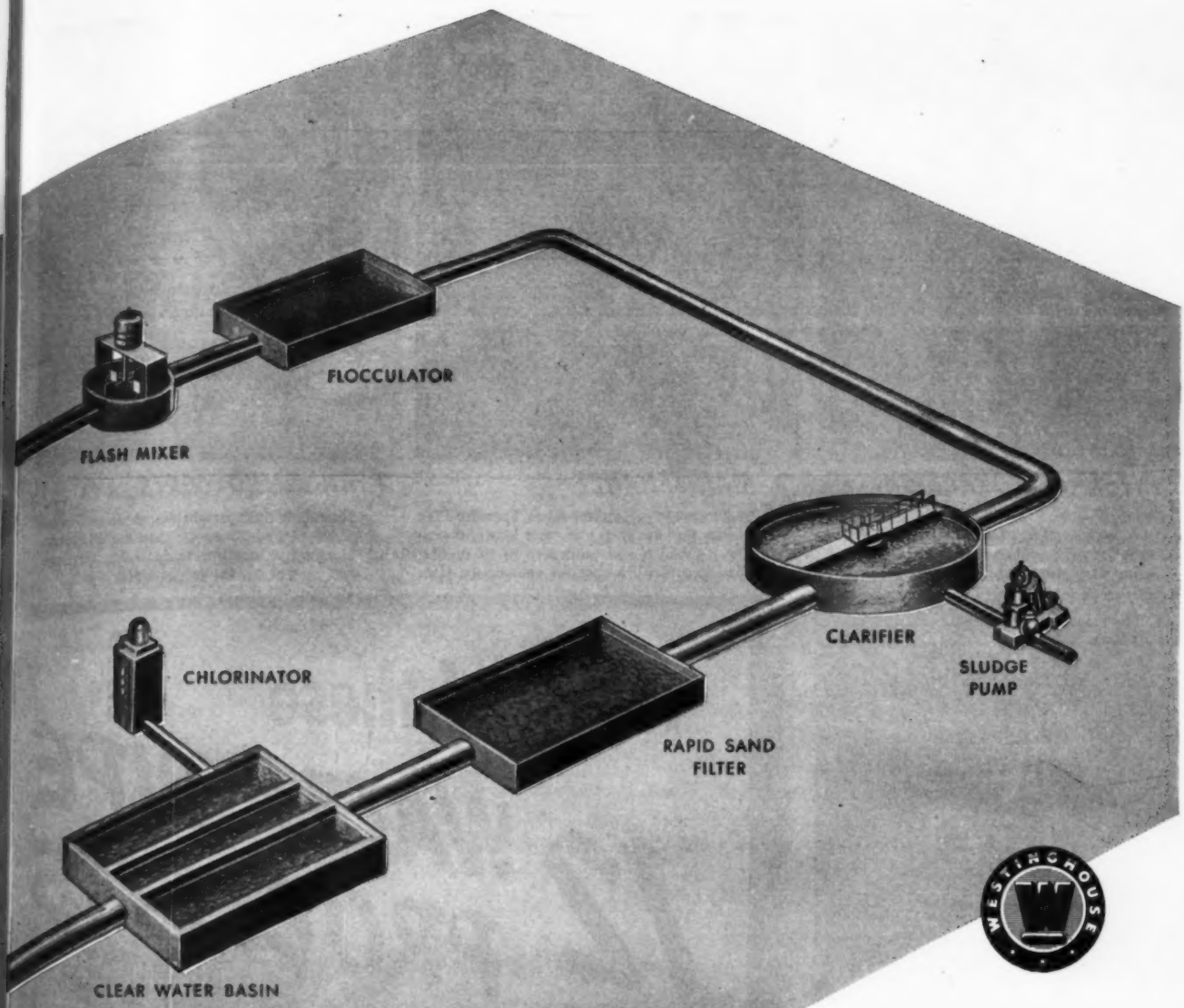
J-94735

Westinghouse
PLANTS IN 25 CITIES... OFFICES EVERYWHERE

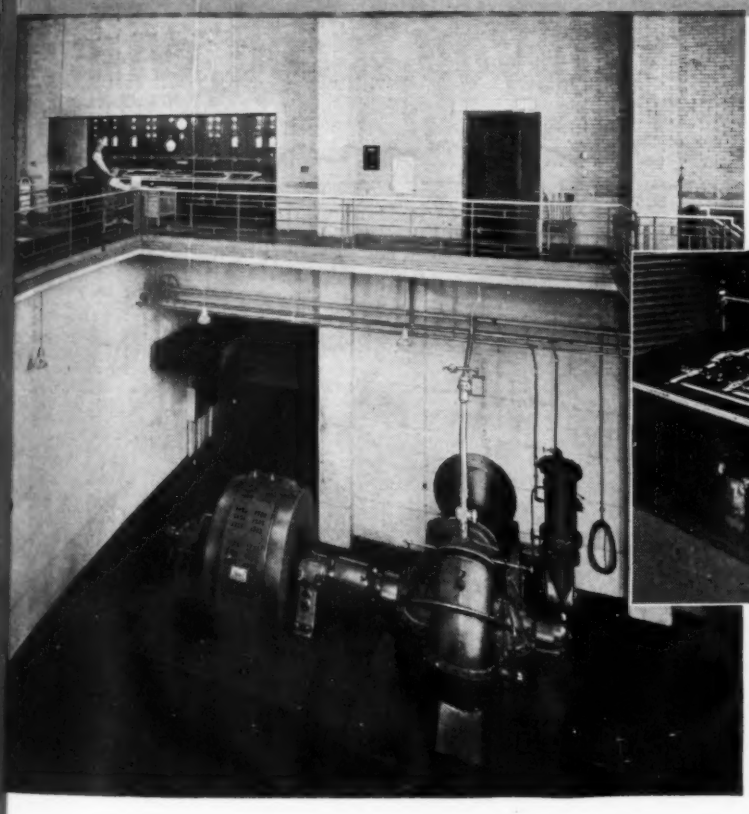
WESTINGHOUSE

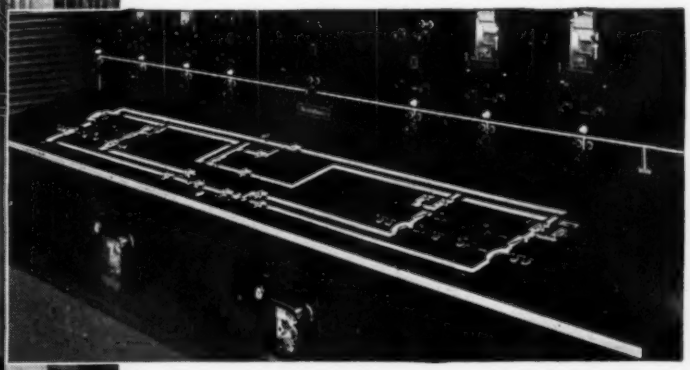
COMPLETE ELECTRICAL EQUIPMENT FOR WATERWORKS

Power flow behind the waterflow...Westinghouse



Luminous diagram on desk of control board visualizes actual water flow at all times.





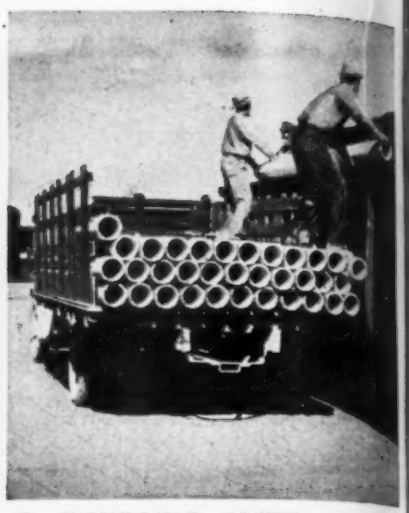
Westinghouse control desk at Lake Erie low-pressure station, City of Toledo, Ohio. 700-hp Westinghouse motor is shown in foreground.

1. INTERNAL CORROSION

Asbestos-cement Transite Pipe cannot cause "red water." And its initial high flow rate is not affected by that most costly form of internal corrosion—tuberculation.

2. MAINTENANCE

In thousands of communities, Transite Pipe —with its advantages of tight joints, corrosion-resistance and immunity to tuberculation— provides low-cost water transportation.



3. HANDLING COSTS

Transite's light weight means more footage per truckload . . . easier handling all around. Mechanical handling equipment is not necessary except for the larger sizes.

7. TRENCHING COSTS

Trenching costs are low with Transite (as indicated above)! No bell holes are required at the joints—width of trenches and disturbance to pavement are kept to a minimum.

Which of these 12 WATER PIPE PROBLEMS are you faced with?

9. SOIL CORROSION

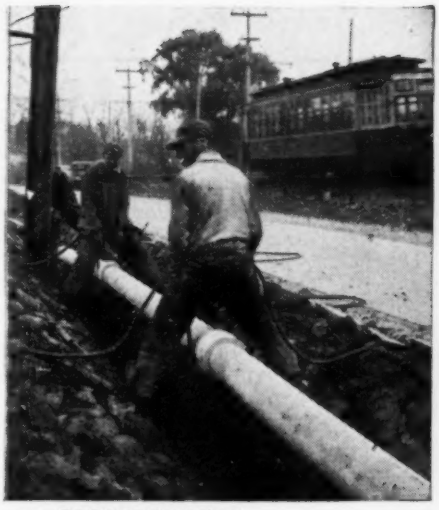
Many a user has found Johns-Manville Transite Pipe the answer to this vexing problem. In numerous installations—many in highly aggressive soils—it has proved stubbornly resistant to corrosion.

10. DELIVERY CAPACITY

Because Transite is non-metallic, its initial high flow coefficient (C=140) is unaffected by tuberculating waters. Progressive reduction of delivery capacity due to tuberculation is never a problem in a Transite water line!

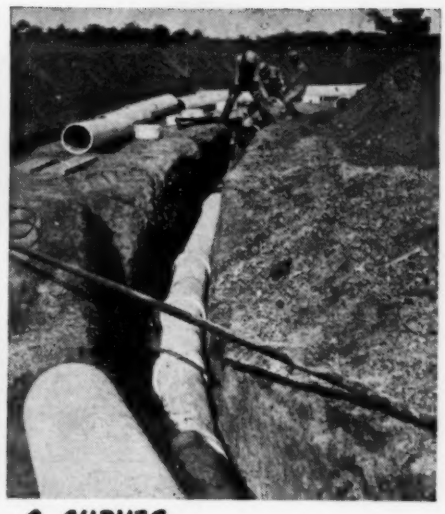
4. INSTALLATION COSTS

Fast assembly, with the Simplex Coupling, keeps installation costs low, minimizes traffic tie-ups. Transite can be tapped and drilled with standard waterworks equipment.



5. ELECTROLYSIS

Stray electric currents cannot damage this non-metallic pipe. As shown above, it can be laid near street railways and power lines with permanent freedom from electrolysis.



6. CURVES

Sweeps like that shown above present no problem with Transite Pipe. Flexible Simplex Couplings permit deflections up to 5° at each joint without use of fittings.

HERE are twelve problems frequently met in water transmission and distribution lines—twelve problems to which Johns-Manville Transite Pressure Pipe provides a practical answer. Check the list . . . and find out how this modern asbestos-cement pipe can help you get more efficient, more economical water transportation over the years.

For more complete information, write for Brochure TR-11A. Johns-Manville, 22 East 40th Street, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville
TRANSITE PRESSURE PIPE
An Asbestos Product

8. JOINT LEAKAGE

Forming a tight yet flexible joint, the Simplex Coupling cuts down costly underground leakage . . . safeguards against washing away of supporting soil and undermining of the pipe.

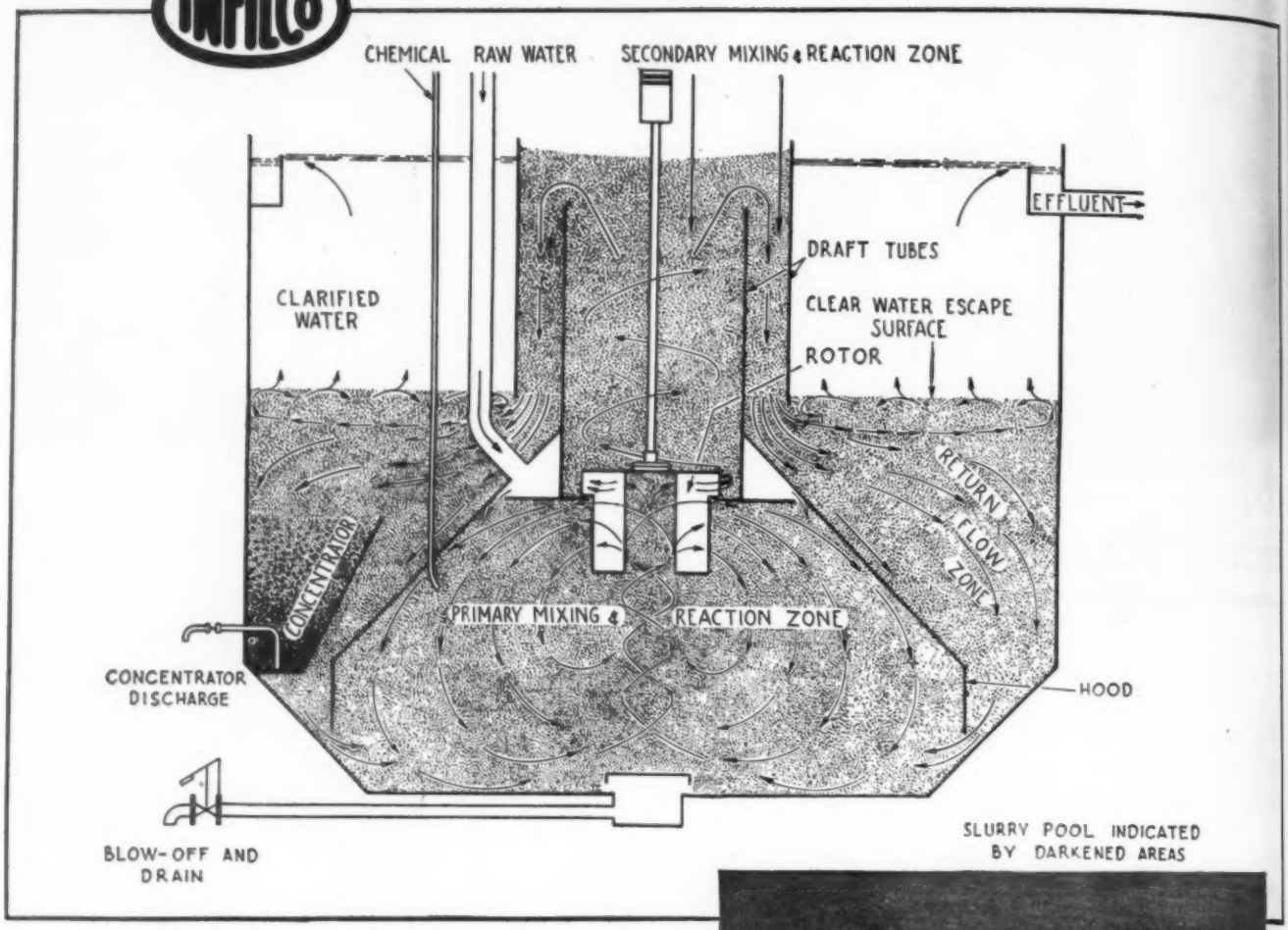
11. SOIL STRESSES

Three factors effectively guard against soil stresses in a Transite water line installation—the high, uniform strength of the pipe itself, its great resistance to corrosion, and the tight, flexible Simplex Couplings.

12. VIBRATION

Transite's flexible joints effectively absorb the vibration of heavy traffic—an especially important consideration wherever pipe is laid under busy streets and highways, or in the vicinity of railway and streetcar tracks.

INFILCO



One compact unit *combines all steps* in water pre-treatment

A product of Infilco research.

Here's a departure in water treating methods that will amaze you. It's rapidly becoming the standard method. It's the Infilco ACCELATOR. As to performance . . . the ACCELATOR pictured above pre-treats 1500 gallons of water per minute—in one-fifth the space needed by a conventional plant of equal capacity. Performance is equally as spectacular for ACCELATORS of all capacities.

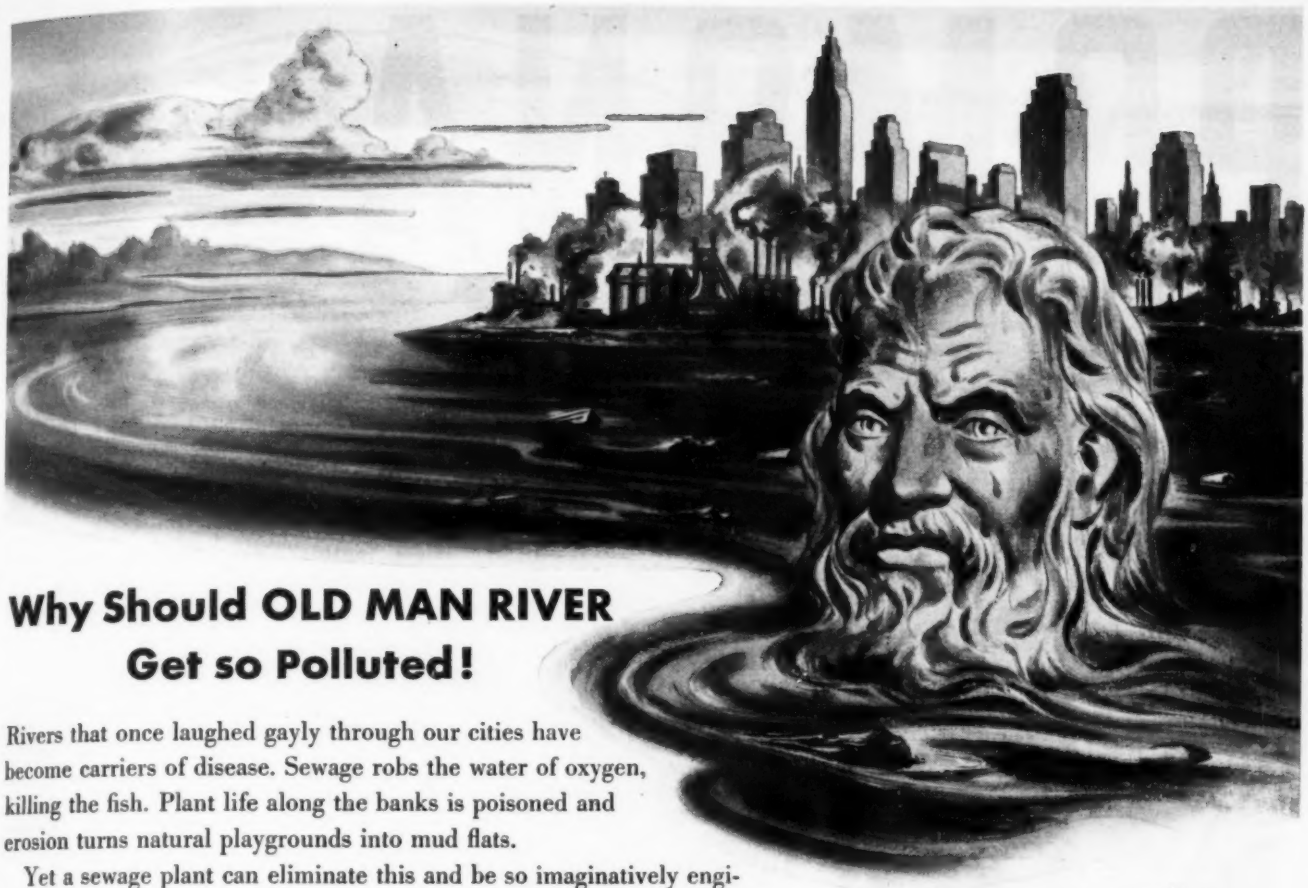
This tested method, the ACCELATOR method, was developed by Infilco research to combine the functions of rapidmix, coagulation and sedimentation. But the ACCELATOR does this and more.

Based on the principle of continuous re-circulation of chemicals and water, ACCELATOR treatment is always uniform. Chemicals are used sparingly and effectively. Water reaches equilibrium in a matter of minutes—often eliminating the need for recarbonation. And there's no need for auxiliary sludge thickeners —with the ACCELATOR sludge removal is continuous and automatic.

Typical ACCELATOR installation. This unit softens 2.2 million gallons of water daily.

Used for softening . . . clarifying . . . stabilizing, ACCELATORS are regularly reported to produce results superior to those obtained with conventional type plants. Write for your copy of the *What, How and Why of the Accelator*. INFILCO INC., 325 West 25th Place, Chicago 16, Illinois.

CONSULT INFILCO — FIRST IN WATER AND SEWAGE TREATMENT



Why Should OLD MAN RIVER Get so Polluted!

Rivers that once laughed gayly through our cities have become carriers of disease. Sewage robs the water of oxygen, killing the fish. Plant life along the banks is poisoned and erosion turns natural playgrounds into mud flats.

Yet a sewage plant can eliminate this and be so imaginatively engineered as to pay a large part of its maintenance. For instance, air forced through a tank of waste by Roots-Connersville blowers changes the chemical nature of the impurities eventually causing them to settle. Pacific centrifugal pumps push this sludge into a digester tank through pipes securely but flexibly joined with Dresser couplings. Here, fermentation causes it to yield combustible gases. These gases, drawn off into Stacey Bros. storage holders, can be used to fire Bryant boilers. The gas may also be used to fuel Clark engines which direct-drive the R-C blowers or which run generators that in turn produce electricity for the whole plant. Engineered to lift itself by its boot straps, a large plant can pay about one third of its operating expenses from its own processes.

There is no price high enough to measure the gain in health, recreation and beauty that follows the transforming of waste waters into sparkling streams at little cost through the teamed efforts of these members of Dresser Industries, Inc.

BOVAIRD & SEYFANG Manufacturing Co., Bradford, Pa.

BRYANT Heater Company, Cleveland, Ohio and Tyler, Texas

CLARK Bros. Co., Olean, New York

DAY & NIGHT Mfg. Co., Monrovia, Calif.

DRESSER Manufacturing Div., Bradford, Pa.

DRESSER Manufacturing Company, Limited, Toronto, Ont., Canada

INTERNATIONAL Derrick & Equipment Co., Columbus, Marietta & Delaware, Ohio; Beaumont, Texas; Torrance, Calif.

KOBE, Inc., Huntington Park, Calif.

PACIFIC Pumps, Inc., Huntington Park, Calif.

SECURITY Engineering Co., Inc., Whittier, Calif.

PAYNE Furnace Co., Beverly Hills, Calif.

ROOTS-CONNERSVILLE Blower Corporation, Connersville, Ind.

STACEY BROS. Gas Construction Company, Cincinnati, Ohio

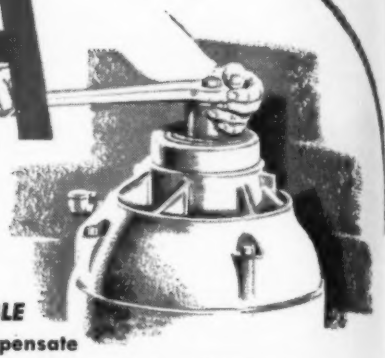
VAN DER HORST Corporation of America, Olean, New York

Creative Engineering FOR PUBLIC WORKS

DRESSER INDUSTRIES, INC.

TERMINAL TOWER • CLEVELAND 13, OHIO

POMONA



ADJUSTABLE

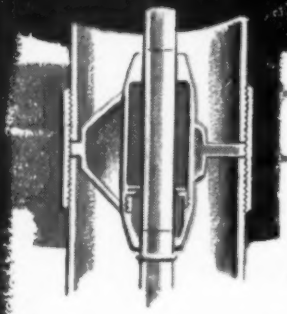
You can compensate your Pomona pump for wear—restore proper running clearance when at last it's necessary —by one simple "topside" adjustment. No need to pull the pump to eliminate recirculation; no high adjustment costs—and valuable pumping time is saved!

Where there's a well ...here's the way!

For pumping water from wells, pits, sumps, lakes, rivers, etc., here's the way to cut costs per gallon to the barest minimum—not only in the first year, but for many, many years to come! Pomona vertical turbine pumps have the combination you're after— high, maintained efficiency for continued low power cost, plus lowest yearly maintenance expense!

NO HIDDEN LEAKAGE!

Pomona, another product of Fairbanks-Morse, protects your pocketbook against power losses and wasted water with a readily accessible shaft seal, or "packing box." Quick visual inspection and easy maintenance are assured!



WHAT DO YOU NEED? **The patented Pomona revolvable, water-lubricated rubber bearing with double (inside and out) bearing surfaces means quiet vibration-free shaft support under all conditions. Fairbanks-Morse vertical turbine pumps are built in sizes from 4" to 36"—with oil or water-lubrication—semi-open or enclosed impellers. Call your nearest Fairbanks-Morse office or your Pomona dealer for information on the pump best fitted to your job.**

FAIRBANKS-MORSE

A name worth remembering

DIESEL LOCOMOTIVES • DIESEL ENGINES • MAGNETOS • GENERATORS • MOTORS • PUMPS
SCALES • STOKERS • RAILROAD MOTOR CARS and STANDPIPES • FARM EQUIPMENT

Thank you, gentlemen!

"Among its many advantages we notice in particular that the initial joint seepage is very slight and it takes up in an exceptionally short time."

"We have never experienced such satisfactory results as we have with the use of BOND-O."

"In 31,700 feet installed, we have not been compelled to cut out a single joint."

"After the line was completed, a test of 125 pounds pressure was put on the main and not one leak appeared in the BOND-O joints, whereas there were so many small ones in the [illegible] joints."

"The report from my field men indicates that the BOND-O gave much better joints than the [illegible] and indicated less shrinkage."

"Our specifications for future work provide for the use of BOND-O (superfine)."

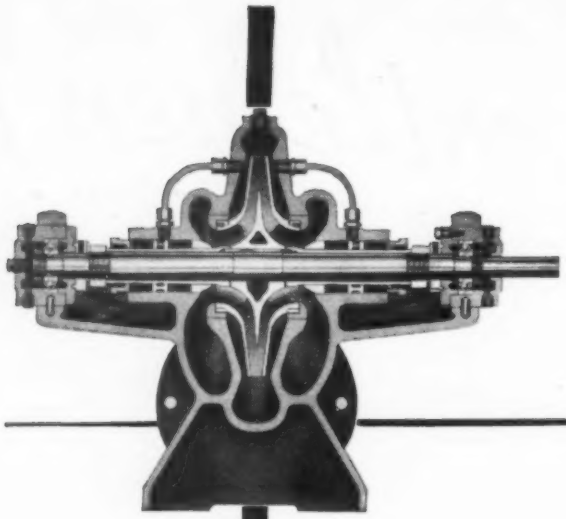
"We have had especially good experience with BOND-O where the pipe was laid in trenches where ground water was encountered."

THANKS to so many of you who have written to us telling about the good results you experienced in using BOND-O. We wish we could print all of your fine comments.

Our method of machine-blending plus the care we give to every batch of BOND-O we make is one of the reasons BOND-O is so satisfactory.

If you have not used BOND-O —compare—and you will see the difference.

NORTHROP & COMPANY, INC.
50 CHURCH ST., NEW YORK 7, N. Y.

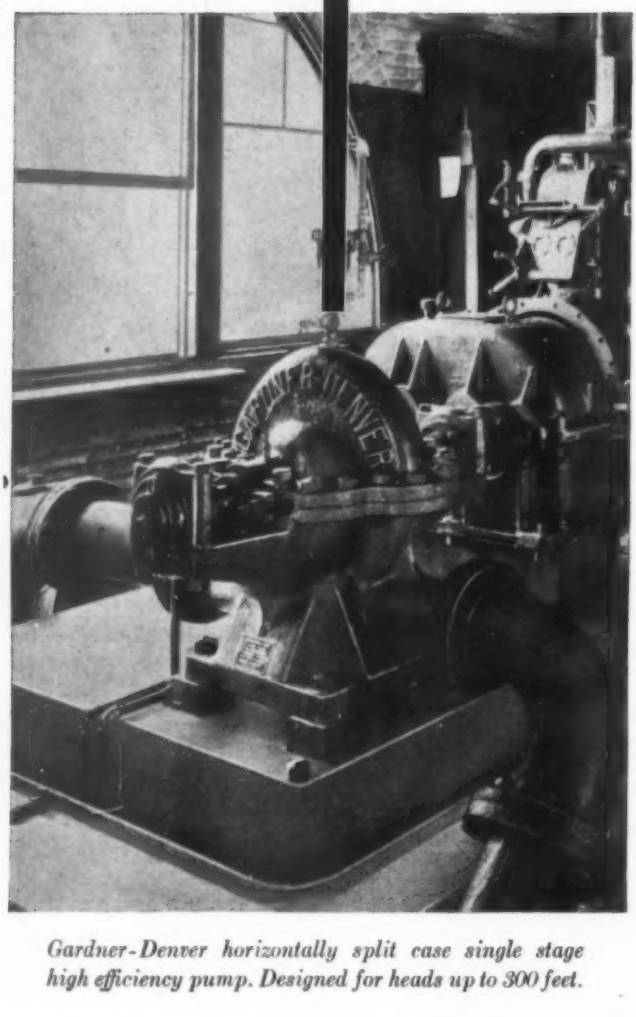


The Inside Story of a *Better Pump*

Look inside a Gardner-Denver horizontally split case double suction centrifugal pump. Then it's easy to see why these pumps have high efficiency—why they frequently save enough in power costs to pay for pump and motor within a single year!

Water passages are properly proportioned to produce an even, uniform flow of water through the pump. Cartridge type bearing housings protect the ball bearings. The cast bronze parts are all high tensile hard bronze—impeller shaft sleeves are hard bronze. Shafts are made of high carbon alloy steel, having a tensile strength in excess of 100,000 pounds per square inch. Cast iron used in this pump has a tensile strength above 40,000 pounds per square inch.

Backed by 87 years of Gardner-Denver manufacturing experience, Gardner-Denver centrifugals will prove their greater worth in your installation. For complete information, write Gardner-Denver Company, Quincy, Ill.

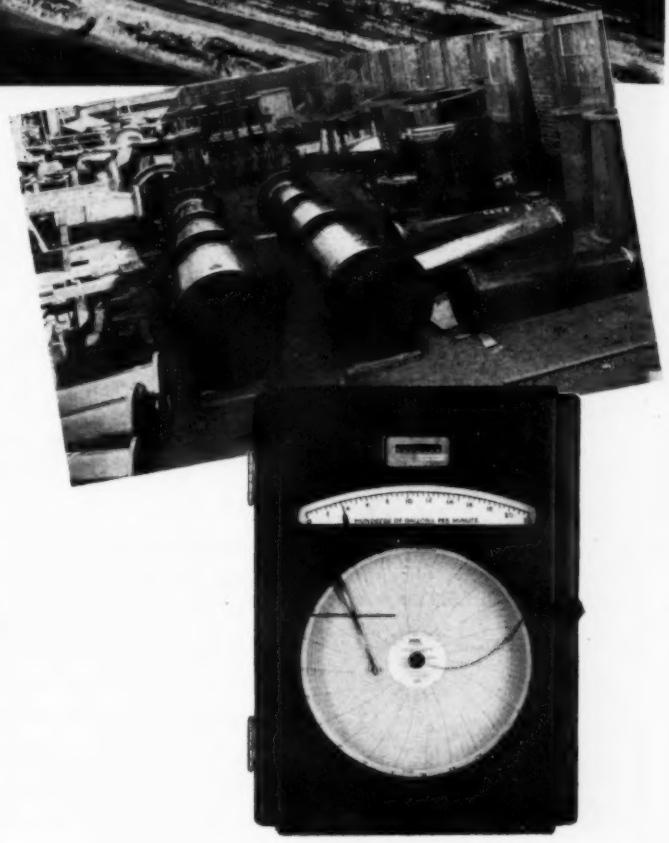


Gardner-Denver horizontally split case single stage high efficiency pump. Designed for heads up to 300 feet.

GARDNER-DENVER

Since 1859

New Additions More Than Double Capacity of World's Largest Sewage Treatment Plant



THE END OF THE WAR has permitted the Sanitary District of Chicago to proceed with the long-planned extension to its famous Southwest Plant, increasing its capacity from 400 to 900 millions of gallons daily. Eight huge Venturi Meters, averaging 9 ft. in diameter, will measure the total incoming raw sewage. Many other Venturis, 5 ft. to 6 ft. in size, will measure the return sludge, mixed liquor, and main air flows; smaller sizes for waste sludge and individual air lines.

Sewage treatment plants must depend, day in and day out, upon reliable meters if there is to be efficient operation. SIGNIFICANT, IS IT NOT, THAT THE NEW ADDITION, LIKE THE ORIGINAL PLANT, WILL BE EQUIPPED THROUGHOUT WITH BUILDERS VENTURI METERS? Included will be Builders Secondary Chronoflo Meter Instruments on a centrally located panel.

All over the country sewage treatment plants, both large and small, are depending upon Builders Venturi Meters. For bulletins, address Builders-Providence, Inc., (Division of Builders Iron Foundry), 10 Codding Street, Providence 1, R. I.

BUILDERS Venturi Meters for the new Southwest Plant at Chicago:

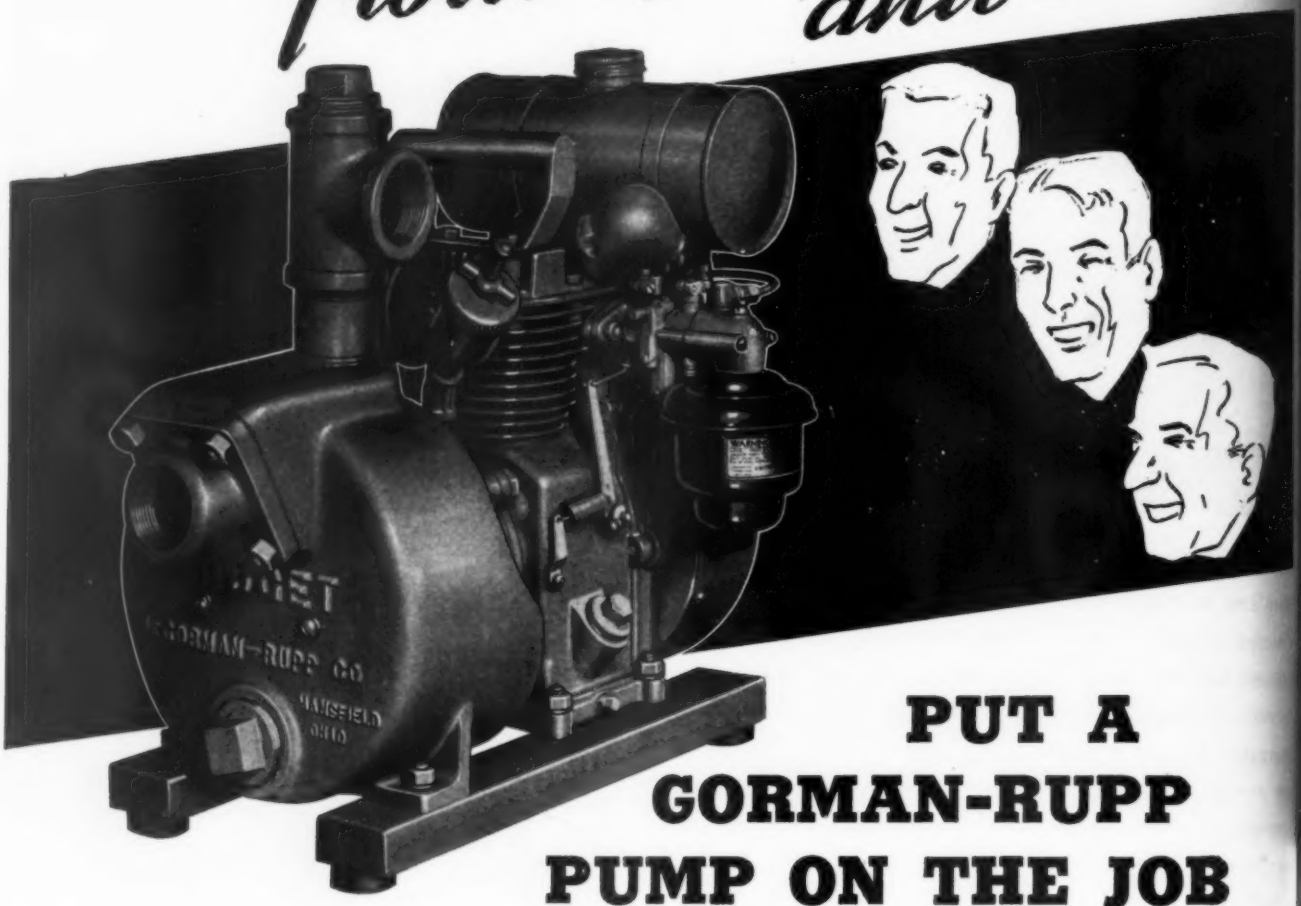
4 — 100″ Raw Sewage Meters
1 — 78″ Return Sludge Meters
8 — 66″ Mixed Liquor Meters
1 — 20″ Waste Sludge Meter
69 — Air Meters (72″ to 4″)

BUILDERS PRODUCTS

VENTURI, PROPELOFLO AND ORIFICE METERS • TYPE M AND FLO-WATCH INSTRUMENTS • FILTER CONTROLLERS AND GAUGES • MASTER CONTROLLERS • KENNISON NOZZLES CHRONOFLO TELEMETERS • CONVEYOR SCALES

BUILDERS PROVIDENCE *Instruments*

"Pack up your Troubles" and—



PUT A GORMAN-RUPP PUMP ON THE JOB

You can't go wrong with a trouble-free Gorman-Rupp self-priming, centrifugal pump. They ask no time off for rest or repairs. They will handle any muck or solids that will pass the intake strainer without damage to the pump. They are automatic self-priming; have no valves to tinker with; no by-passes to rob efficiency.

The Midget is the smallest of more than 50 models of Gorman-Rupp pumps. It weighs only 60 pounds and will handle 3000 gallons per hour against a 20 foot head and will do it for months at a time without attention. Gorman-Rupp pumps are made in any size or capacity up to 125,000 gallons per hour.

Put a Gorman-Rupp pump on your next job – give it a tough workout and if it does not out-perform any pump you have used return it at our expense and it will not cost you a cent.

Write for further information or contact your nearest distributor.

For Details call your nearest distributor.

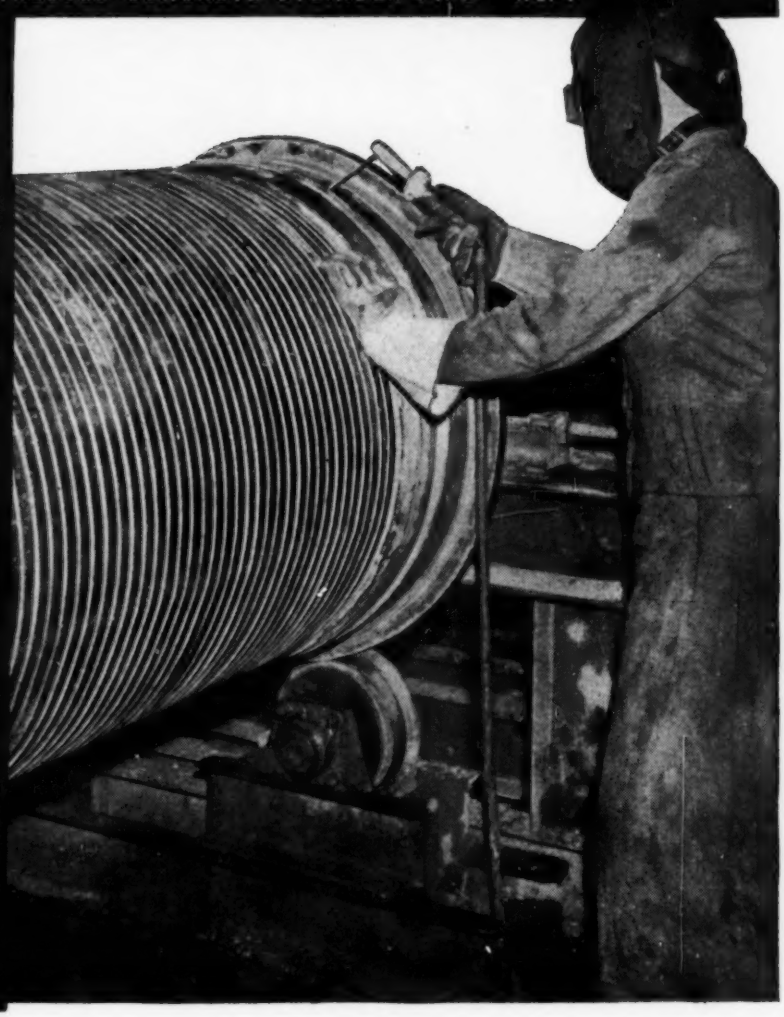
THE GORMAN-RUPP COMPANY

GORMAN-RUPP PUMPS — UNSURPASSED FOR PUMPING FAST

327 Bowman Street — Mansfield, Ohio

ADVANTAGES OF PRESTRESSED CONCRETE CYLINDER PIPE • NO. 1

Higher Pressure Ranges



● PRESTRESSING, already well recognized as the normal trend of development in the design of reinforced concrete structures, is a "natural" for pressure pipes because of their tubular shape.

Lock Joint Pipe Company has applied the principles of prestressing steel in tension and concrete in compression in the design and manufacture of Lock Joint Prestressed Concrete Cylinder Pipe.

Retaining all the inherent advantages of the fundamental principles of Lock Joint pipe design, the use of high tensile steel makes possible still higher pressures in a greater range of sizes in keeping with Lock Joint economy of first cost and maintenance.

When you specify Prestressed Concrete Cylinder Pipe, you can depend upon a pipe of maximum elastic qualities as well as a pipe with the inherent benefits of water-tightness, durability and permanent high carrying capacity of steel cylinder design.

A Hazen-Williams Hydraulic Slide Rule will gladly be sent upon request with our compliments.

LOCK JOINT *Reinforced Concrete* PRESSURE PIPE

LOCK JOINT PIPE COMPANY

Established 1905

P. O. BOX 269, EAST ORANGE, NEW JERSEY

Denver, Colo. • Chicago, Ill. • Kenilworth, N. J. • Kansas City, Mo. • Rock Island, Ill. Joplin, Mo. • Valley Park, Mo. • Cleveland, Ohio • Hartford, Conn. • Navarre, Ohio

SCOPE OF SERVICES *Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains of large diameter as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous lines.*

So He Called a Deming Distributor

Pump catalogs are an indispensable source of reference. The Deming "Library of Pump Data" includes a wealth of information in readily available catalogs and bulletins on the highly diversified line of Deming Pumps.

But no catalogs, however informative and authoritative, can match the LOCALIZED information of the Deming Distributor in your area.

In numerous instances, it is this LOCALIZED information "on tap" at your nearest Deming Distributor that points to a quick solution to a seemingly difficult or "unusual" pumping problem. When you call your Deming Distributor for help on almost any problem involving pumping equipment, the chances are good that he can show you how a comparable problem was solved successfully in a near-by plant.

This combination of *"know-how and know-where"* on the part of the Deming Distributor organization nearest your plant is beyond the scope of catalog compilation.

The quickest route to the right pump for specific needs is through your nearest Deming Distributor.

BOILER FEED PUMPS
CELLAR DRAINERS
CENTRIFUGAL PUMPS
CONDENSATION PUMPS
DEEP WELL PUMPS
DIAPHRAGM PUMPS
DRAINAGE PUMPS
PORTABLE PUMPS

DEMING
THE COMPLETE LINE
PUMPS AND WATER SYSTEMS
The Deming Company · Salem, Ohio

ROTARY PUMPS
SELF PRIMING PUMPS
SEWAGE PUMPS
SLUDGE PUMPS
SUCTION AND FORCE PUMPS
SUMP PUMPS
TURBINE PUMPS

"In our main plant we have 2 Climax R8I 200 H.P. engines . . . direct connected to 4 M.D.G. booster pumps. These engines were installed in 1936 and have been in service ever since. We find them very dependable and satisfactory . . ." Carl Duy, Engineer of Waterworks, Aurora, Ill.

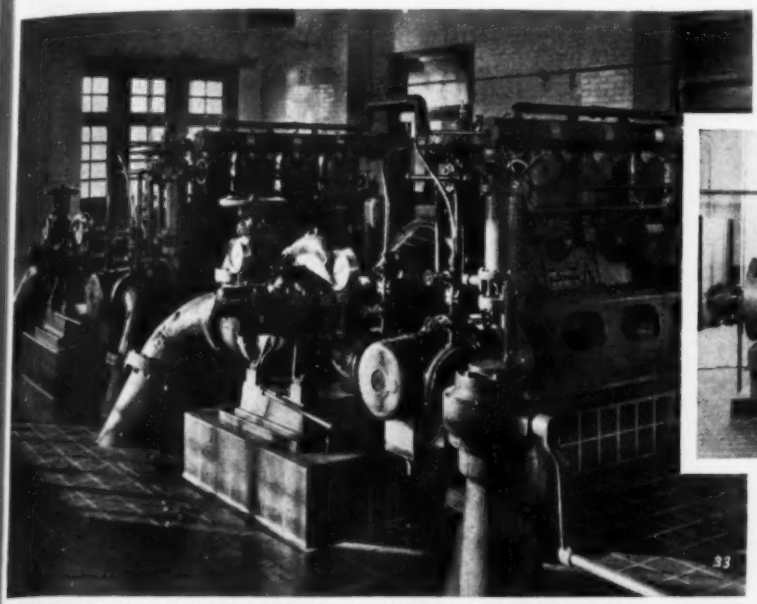
Of Climax R6I in standby service 10 years, John P. Stark, Supt. of Waterworks, Goshen, Indiana, says: "The engine has met every test successfully and has never let us down."

"We have had wonderful success with the Climax standby unit," says J. J. Hail, Supt. Water Department, Dubuque, Iowa.

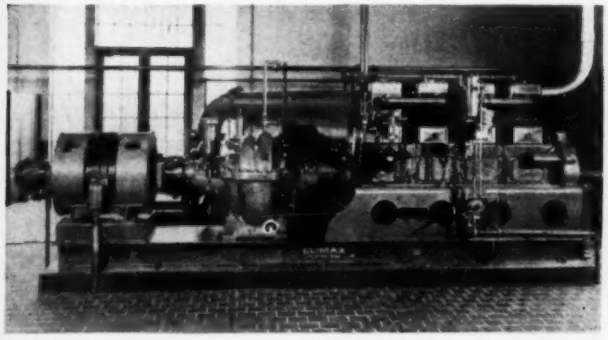
E. B. Lloyd, Chief Engineer and Chemist of Elgin City Water Department says, "The reliability of this (Climax) standby equipment is a factor in keeping our city in a low insurance classification by the National Board of Fire Underwriters and the Illinois Inspection Bureau."

EXPERIENCE OF WATERWORKS ENGINEERS

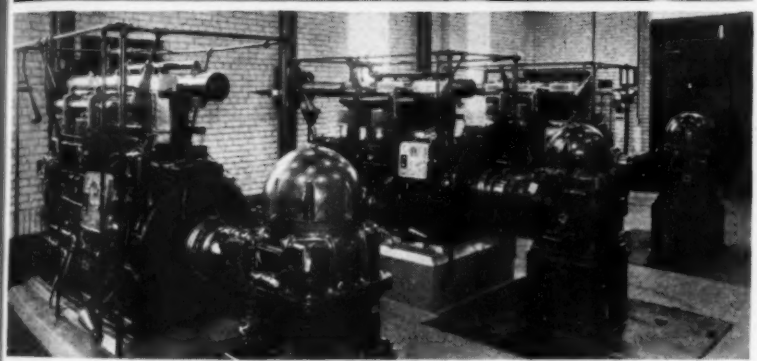
points the way to low cost dependable power for new pumping stations!



AT LEFT: Two Climax R8I Engines Direct Connected to High Pressure Centrifugal Pumps. Waterworks, Aurora, Ill.



ABOVE: Climax R8I Engine Direct Connected to 200 H.P. Motor Driven Pump. Waterworks, Dubuque, Iowa.



Three Climax R6I Engines Direct Connected to Vertical Turbine Pumps Through Right Angle Gears. Dwight Street Pumping Station, Chicopee, Mass.

One of two R4I Engines with Pressure Regulators Direct Connected to Centrifugal Pumps. Douglaston Pumping Station, Queens, New York.

The Engineers' Standby

CLIMAX ENGINES are used to supply dependable power—at a moment's notice—during purchased power outages. Also to keep down maximum demand charges during emergency periods of peak water consumption. In many plants Climax engines are used as the source of *primary* power because of their extremely low maintenance and economy of operation on natural or by-product gas, as well as on butane or gasoline.

* * *

BEFORE APPROVING NEW INSTALLATIONS CONSIDER CLIMAX ENGINES—There are 4, 6, 8 and 12 cylinder, 4-cycle types. For complete information and specification bulletins, write Climax Engineering Company, Clinton, Iowa.

climax
BLUE STREAK ENGINE
Builder of Climax DIESELS and GENERATING SETS
CLIMAX ENGINEERING COMPANY

..for peak Efficiency

At the East Rutherford, New Jersey, Joint Meeting Sewage Disposal Plant, peak efficiency and long life have been assured by including Ludlow Valves in the installation.

This view shows the upper level where the primary clarifier is located. Here Ludlow List 4 Gate Valves, and Ludlow Swing Check Valves, connected to centrifugal pumps handle the effluent from the Secondary Wet Well. Other Ludlow List 4 Gates are located in the lower level, controlling the flow from the Primary Wet Well.

Ludlow's constant research in both materials and design have made possible many added refinements and developments in Ludlow Valve manufacture. It will pay you to look into Ludlow equipment . . . first.

• GATE VALVES • CHECK VALVES • SLUICE GATES •

The LUDLOW VALVE SINCE 1866
MFG·CO·INC·TROY·N·Y·

DEPENDABILITY

Water works men in all parts of the country can attest to the fact that HYDRO-TITE has joined thousands of miles of cast iron bell and spigot pipe with complete success.

HYDRO-TITE is easy to prepare—pours perfectly—sets up fast with practically no initial leakage. Used for over 30 years, it is a time-tried and proven product. Used with FIBREX it is an unbeatable combination for permanently tight joints.

A sanitary packing used like braided jute—to insure a clean, tight bacteria-free joint. FIBREX comes in 60-lb. reels. Super-FIBREX has a synthetic rubber coating—comes redi-cut to exact pipe size. No waste—every length a perfect fit.

A PIPE LINE IS ONLY AS STRONG AS ITS JOINTS

HYDRO-TITE

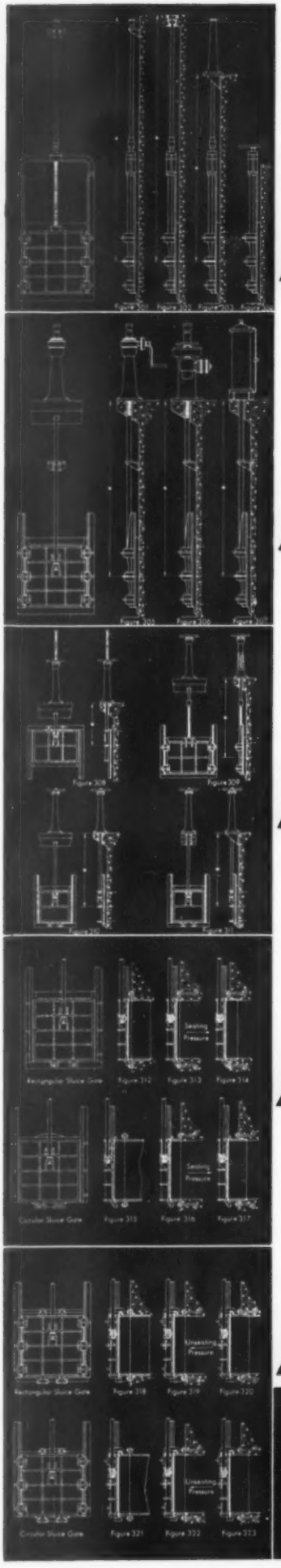
A DEPENDABLE SELF-CAULKING JOINTING COMPOUND

Super FIBREX Plus

BACTERIA-FREE RUBBER-COVERED. USED LIKE BRAIDED JUTE

HYDRAULIC DEVELOPMENT CORPORATION

Main Sales Office: 50 Church Street, New York, N. Y.


Non-Rising Stem Sluice Gates
Rising Stem Sluice Gates
Rising Stem Sluice Gates
Seating Pressure Sluice Gates
Unseating Pressure Sluice Gates

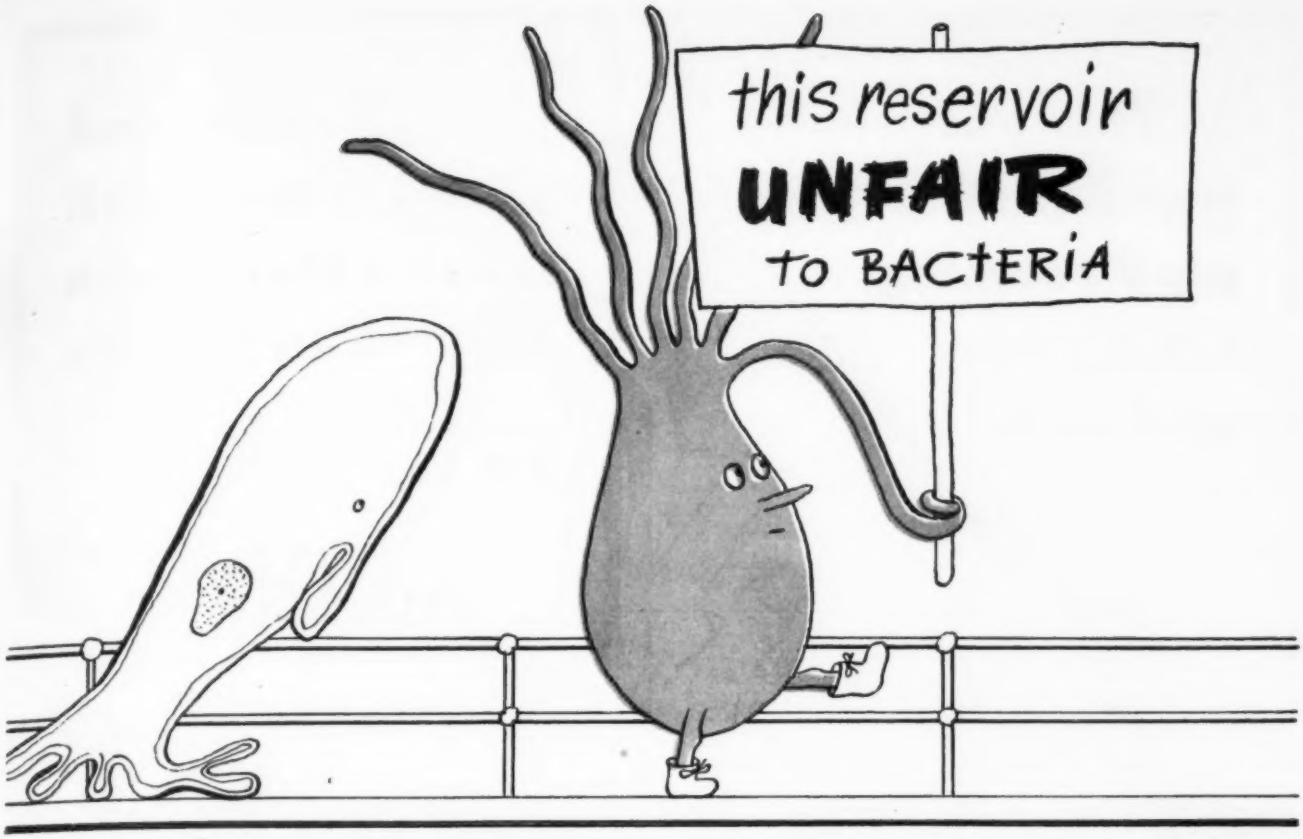
SLUICE GATE TYPICAL INSTALLATIONS

Many engineers and designers make it a practice to consult Mueller Co. on water control projects because they have found that they can usually fill their requirements out of the Mueller-Columbian regular line without designing special equipment. For example, the regular line of Sluice Gates come in all standard sizes up to 96 by 96 inches. They may be rectangular or circular with either rising or non-rising stems and with or without adjustable wedges on top, bottom or sides. The operation may be manual, hydraulic or electric. Precise machining to templates and guages, interchangeability of parts and thorough pretesting insures quick and accurate installation on the job with years of trouble-free operation. Consult Mueller Co. on your requirements.

Other Mueller Products

Check Valves	Shear Gates	Mud Valves
Floor Stands	Flap Valves	Foot Valves
Bench Stands	Gate Valves	Gate Hoists

MUELLER CO.
CHATTANOOGA, TENN.



the water's been treated with

PITTCHLOR

Poor Orgie and his pal are on strike. They know what happens when Pittchlor—with its 70% available chlorine—is added to water supplies. But this time they're out of luck. If there is one thing Pittchlor is unfair to, it's chlorine-susceptible micro-organisms. This high-test calcium hypochlorite is highly effective for the chlorination of water . . . the treatment of sewage . . . as a deodorant . . . as a disinfectant. It's easy to use. Buy it from your jobber. Packed in: 3¾-lb. cans, 5-lb. resealable cans, and 100-lb. drums. Write for literature today!

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PITTSBURGH PLATE GLASS COMPANY
COLUMBIA CHEMICAL DIVISION

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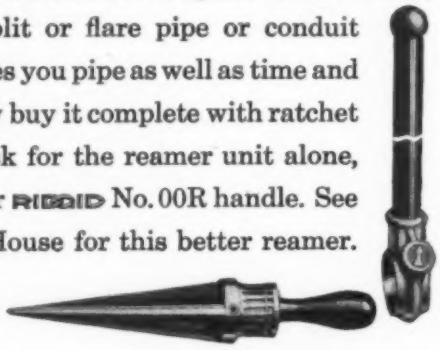
COLUMBIA ESSENTIAL INDUSTRIAL CHEMICALS
Soda Ash • Caustic Soda • Liquid Chlorine • Sodium Bicarbonate • Pittchlor (*Calcium Hypochlorite*) • Silene EF (*Hydrated Calcium Silicate*) • Calcium Chloride • Soda Briquettes (*Iron Desulphurizer*) • Modified Sodas • Caustic Ash • Phosflake (*Bottle Washer*) • CalceneT (*Precipitated Calcium Carbonate*)

This extra-long taper makes your pipe reaming quick, easy and safe

RIDGID

LonGriP Pipe Reamer

● The trick of its efficient performance is in that extra long taper—it reams burr cleanly from any pipe in a few easy ratcheted strokes—practically no pressure required. Even more important than that, it won't thin, split or flare pipe or conduit wall. That saves you pipe as well as time and work. You may buy it complete with ratchet handle—or ask for the reamer unit alone, which fits your RIDGID No. 00R handle. See your Supply House for this better reamer.



Reamer unit fits RIDGID No. 00R handle.

You thread small pipe with least effort with this tough little

RIDGID

No. 0R

● Speedy and a worksaver, when you want to cut perfect threads on ⅛" to 1" pipe. This smart steel-and-malleable internal ratchet threader has precision-made heat-treated tool-steel dies, each factory tested . . . for smooth fast threading. Die heads snap in from either side, can't fall out. No special dies needed for close-to-wall work. No. 0R, ⅛" to 1"; No. 11R, ⅛" to 1¼." You'll like these durable efficient RIDGIDs for small pipe. Ask your Supply House.

Chasers easily reverse for close-to-wall threads.

Millions of RIDGID Tools in use

RIDGID

WORK-SAVER PIPE TOOLS

The Ridge Tool Company
Elyria, Ohio, U. S. A.

CHEMICAL USERS' GUIDE To General Chemical Company Products for Treatment of Water, Sewage, and Industrial Wastes

PRODUCT	AVAILABLE FORMS	COMMERCIAL STRENGTH (MIN.)	SHIPPING CONTAINERS	APPLICATIONS
Aluminum Sulfate $Al_2(SO_4)_3 \cdot 14H_2O$ approx. *(Filter Alum)*	Commercial & Iron Free: Lump • Ground Powdered	17.25% Al_2O_3	Bags Barrels • Drums Bulk Carloads	Coagulant for water and sewage. Dewatering conditioner for sewage sludge. 1% Sol. pH 3.4.
Aqua Ammonia NH_4OH plus Water *(Ammonia Water)*	Colorless Liquid	26°Be. (29.4% NH_3)	Steel Drums Carboys	Used with chlorine to form chloramines for water disinfection.
Ammonium Aluminum Sulfate $Al_2(SO_4)_3 \cdot (NH_4)_2SO_4 \cdot 24H_2O$ *(Ammonia Alum) (Crystal Alum)*	Lump Nut Granular Powdered	11.2% Al_2O_3	Bags Fibre Drums	Coagulant for water. Advantageous for pressure filters. Supplies ammonia for chloramine formation. 1% Sol. pH 3.5.
Sodium Bisulfite, Anhydrous $Na_2S_2O_5$ *(ABS) (Sodium Metabisulfite)*	Powdered	97.5% $Na_2S_2O_5$ (Equiv. 65.5% SO_2)	Fibre Drums	Antichlor. Remove iron and manganese deposits from filter sand. 1% Sol. pH 4.6.
Sodium Silicate $Na_2O \cdot X(SiO_2)$ plus H_2O *(Water Glass) (Silicate of Soda)*	Viscous Liquid	38° to 52°Be. Various Ratios of $Na_2O:SiO_2$	Drums Tank Cars Tank Trucks	1. Aid in floc formation. 2. Prevent red water corrosion in distribution lines. 1% Sol. pH 12.7
Sodium Thiosulfate $Na_2S_2O_3 \cdot 5H_2O$ *(Hypo) (Sodium Hyposulfite)*	Crystals: Prismatic Rice Selected Universal Granular	99.75% $Na_2S_2O_3 \cdot 5H_2O$	Bags Barrels Fibre Drums	Antichlor. Water solution is neutral.
Sulfuric Acid H_2SO_4 plus H_2O *(Oil of Vitriol)*	Corrosive, oily liquid Various strengths	66°Be. (93.19% H_2SO_4)	Bottles Carboys Drums Tank Trucks Tank Cars	1. Reduce pH and alkalinity. 2. Regenerate carbaceous zeolites and ion exchangers. 3. Activate Baylis Silicate.
Potassium Aluminum Sulfate $Al_2(SO_4)_3 \cdot K_2SO_4 \cdot 24H_2O$ *(Potash Alum)*	Lump Nut Granular Powdered	10.7% Al_2O_3	Bags Fibre Drums	Coagulant for water. Slow, even rate of solubility desirable for solution pot feeders. 1% Sol. pH 3.52.
Sodium Sulfite, Anhydrous Na_2SO_3 *("Sulfite")*	Granular Powdered	98.5% Na_2SO_3	Bags Fibre Drums	Antichlor, oxygen remover. Weak solutions absorb oxygen readily. 1% Sol. pH 9.8.
Sodium Sulfate, Crystal $Na_2SO_4 \cdot 10H_2O$ *(Glauber's Salt)*	Crystal & Needle Crystal	96% $Na_2SO_4 \cdot 10H_2O$	Barrels Bags Drums	Neutral Solution. Boiler water treatment (maintenance of sulfate-carbonate ratio).
Sodium Sulfate, Anhydrous Na_2SO_4	Powdered	99.5% Na_2SO_4	Bags Barrels	Neutral Solution. Boiler water treatment (sulfate-carbonate ratio)
Trisodium Phosphate $Na_3PO_4 \cdot 12H_2O$ *(TSP)*	Crystal	98.5—103% $Na_3PO_4 \cdot 12H_2O$ (Equiv. 19% P_2O_5)	Bags Barrels Fibre Drums	Boiler water treatment. Cleaning compound. 1% Sol. pH 11.8-12.0.
Disodium Phosphate, Crystal $Na_2HPO_4 \cdot 12H_2O$	Crystal	98% $Na_2HPO_4 \cdot 12H_2O$ (Equiv. 19.5% P_2O_5)	Bags Barrels Fibre Drums	Boiler water. (Calcium and magnesium precipitation.) 1% Sol. pH 8.4.
Disodium Phosphate, Anhydrous Na_2HPO_4	Powdered Flake	96% Na_2HPO_4 (Equiv. 48% P_2O_5)	Same	Same as Crystal, but stronger product.
Sodium Fluoride NaF *(Fluoride)*	Powdered (white or blue colored: Nile Blue) Light or dense	90% and 95% NaF	Bags Barrels Fibre Drums	Fluorination of water supplies. (For information, consult with local health officers.)

BASIC CHEMICALS
GENERAL CHEMICAL COMPANY
FOR AMERICAN INDUSTRY

FOR THE LABORATORY: Baker & Adamson Laboratory Reagents

For full information on these and other General Chemical Company products, write or phone the nearest Sales and Technical Service Office below.

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Regular Split Case
Disc Type Model,
5/8" to 1"

Now as always

. . . AMERICA'S FIRST WATER METER

The first water meter patented in the U. S. was a Worthington, in 1855. And after nearly a century of continued development, its direct descendants — Worthington-Gamon "Watch Dog" Meters—still lead in efficient, economical meter performance.

Made of the finest materials, as technically perfect as the most complete research and production facilities can make them, "Watch Dog" Water Meters are today standing guard over the water supplies of thousand of communities with accuracy, durability and low-cost maintenance . . . Before you specify, be sure to investigate the many advantages of Worthington-Gamon "Watch Dog" Meters.

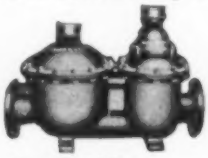
G6-7

"WATCH DOG" WATER METERS

"Watch Dog" Models . . . made in standard capacities from 20 gpm up; frost-proof and split case models in standard household sizes. All meters, Disc type, Turbine type and Compound type, comply with specifications of cold-water meters adopted by American Water Works Association . . . Write for Bulletin.

Made by America's First Meter Manufacturer—
Today's First Choice in Thousands of Municipalities

Disc Type:
1½" to 6"



Compound Type:
2" to 8"

IH Turbine Type:
2" to 8"

WORTHINGTON-GAMON METER COMPANY

296 South Street, Newark 5, New Jersey

Subsidiary of

WORTHINGTON
PUMP AND MACHINERY CORPORATION

Only two cents *per capita* *per year* • • • *that's all it costs* *to use Aqua Nuchar* NUCHAR *Activated Carbon to remove tastes* *and odors* *from your water* *supply* • • •

*Based on average "Taste and Odor Conditions"

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DIVISION WEST VIRGINIA PULP AND PAPER COMPANY

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Over 90 years

OF PROGRESSIVE STORAGE TANK ENGINEERING!

Established in 1854, the R. D. Cole Mfg. Co. has long been recognized as one of the nation's outstanding tank builders. With over 90 years of "progressive storage tank experience" at your disposal, we will welcome the opportunity to serve your tank needs.

ALL SHAPES AND SIZES

The R. D. Cole Mfg. Co. has developed a complete line of elevated steel tanks for water supply, both for domestic service, and sprinkler requirements, ranging in capacity from 5,000 to 2,000,000 gallons. The designs include the standard Hemispherical and Self-supporting bottom, the "Cole Ovaloid", Standpipe, and many individual styles involving architectural treatment to satisfy local conditions, or to provide special shapes for advertising purposes.

STORAGE TANKS

Pressure tanks for storage of gas from digesters at sewage disposal plants so that excess output at peak loads can be used during off-peak periods. Chemical storage tanks, hot water storage tanks, tanks for bulk storage of oils and gas.

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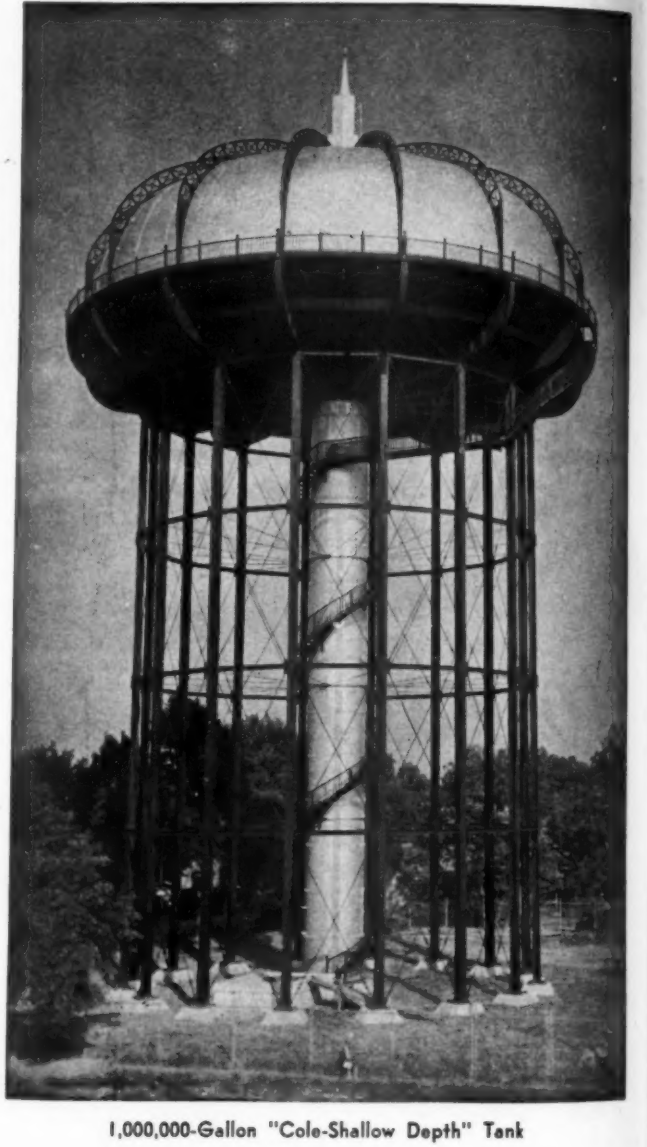
Fabricated steel plate—the R. D. Cole Mfg. Co. has a fully equipped plant for the fabrication of riveted or welded steel plate. In addition to the construction of its regular line of horizontal return tubular boilers, oil storage tanks, tubular heaters, etc., the company is prepared to construct special tanks and apparatus of any specified metal plate.



1,000,000-Gallon "Cole-Shallow Depth" Tank

Designs available for any service, made to your specifications or from our designs submitted by our own Engineering Department.

R. D. COLE MANUFACTURING CO.

Established in 1854

NEWNAN « « GEORGIA

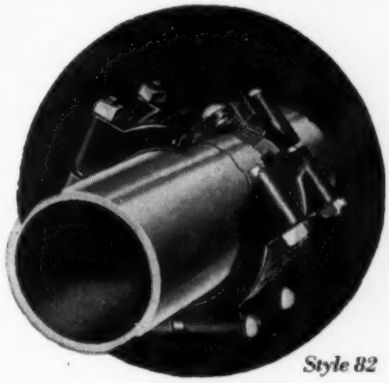
First aid is final aid with Dresser Repair Sleeves. The leak or break is quickly enclosed without interruption of service . . . yet the repair is permanent. Designed for splits, breaks and holes in pipe and pipe joints.

These factory-built "packaged" joints come completely assembled. No complex fitting operations are required in the ditch. Can be installed *Dresser-tight* by any workman.

Order Now for Winter Breaks

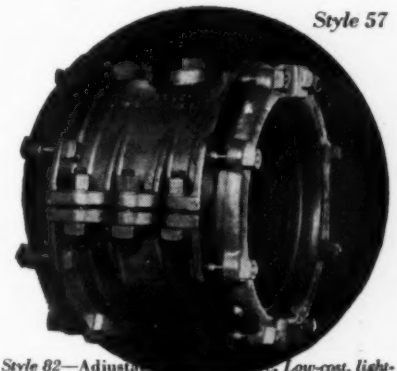
Don't be caught short. Stock up now on Dresser Repair Products. Be prepared to handle breaks as they occur. Two typical sleeves are shown at right. Write for catalogs, Forms 441 and 3711.

DRESSER MANUFACTURING DIVISION, BRADFORD, PA.
Houston Office and Warehouse, 1121 Rothwell St., Sec. 16, Houston, Texas. In Canada, Dresser Manufacturing Co., Ltd., 60 Front St., West, Toronto, Ont.



Style 82

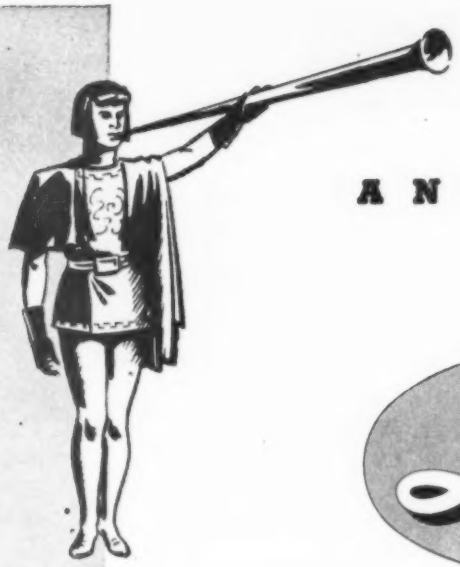
Style 57



Style 82—Adjusta[illegible]. *Low-cost, lightweight* sleeve to fit varying pipe diameters from 4" to 8". Interchangeable sections give adjustability. One man can make a repair with this sleeve in 5 to 10 minutes. Ideal as tapping sleeve.
Style 57—Cast Split Sleeve. Quickly installed. For cast-iron pipe 2" to 12" in diameter. Two or more of these sleeves can be joined together to enclose pipe breaks longer than 8".

DRESSER REPAIR SLEEVES

ONE OF THE DRESSER INDUSTRIES



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A NEW NAME IN

LIQUID CONDITIONING

BACKED BY A QUARTER CENTURY OF EXPERIENCE

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Removal of

Undesired Impurities from Syrups, Juices and Chemical Solutions

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Chemical Products and Mechanical Equipment for Water Conditioning for Household, Industrial and Municipal Use; also for Conditioning of Other Liquids:

Cation and Anion Exchangers
Zeolite Water Softeners
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● If you need soft water . . . clear water . . . pure water . . . or purification of other liquids . . . this announcement is important to YOU.

LIQUID CONDITIONING CORPORATION is a new organization, operated by pioneering experts in liquid conditioning with more than a quarter century of experience in this field.

- The newness of the LIQUON organization means freedom from hide-bound procedure in the approach to and handling of your liquid-conditioning problems.
- The long experience of LIQUON engineers and chemists means full assurance that your problems will be correctly solved. Many modern methods which are now accepted as standard in the art were pioneered by members of this organization.
- LIQUON services are COMPLETE. They include every process . . . apparatus . . . material . . . for any requirement of liquid conditioning.
- Therefore, LIQUON recommendations are authoritative and impartial. Each LIQUON installation is custom-tailored for best results with your precise conditions. And each carries our overall guarantee of performance.

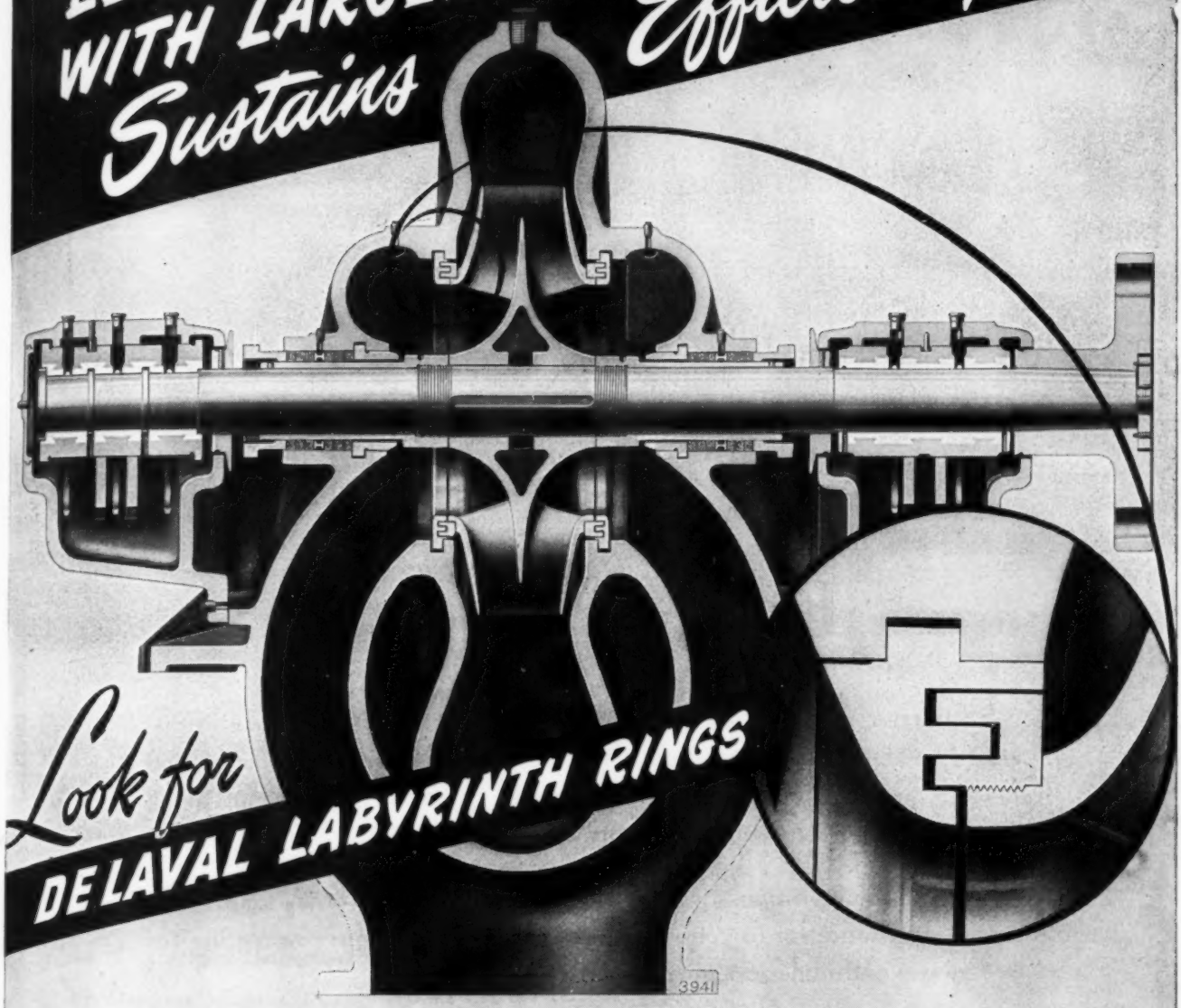
These are the reasons why this announcement is of significance to you . . . why you should consult LIQUID CONDITIONING CORPORATION on your problems concerning water and other liquids.

●

Write us today. Your inquiry will not involve the slightest obligation to you, and may result in important benefits and savings in your plant.

LIQUID CONDITIONING CORPORATION
423 West 126th Street, New York 27, N. Y.

LESS LEAKAGE WITH LARGER CLEARANCES Sustains Efficiency



Look for DE LAVAL LABYRINTH RINGS

De Laval Labyrinth Wearing Rings contribute in a large measure to sustaining the high efficiency of De Laval pumps. The large clearance, tortuous labyrinth passage reduces leakage to a minimum and maintains ample running clearances under all conditions.

For sustained efficiency and reduced maintenance costs look for De Laval Labyrinth Wearing Rings when buying centrifugal pumps.

3235

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

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STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

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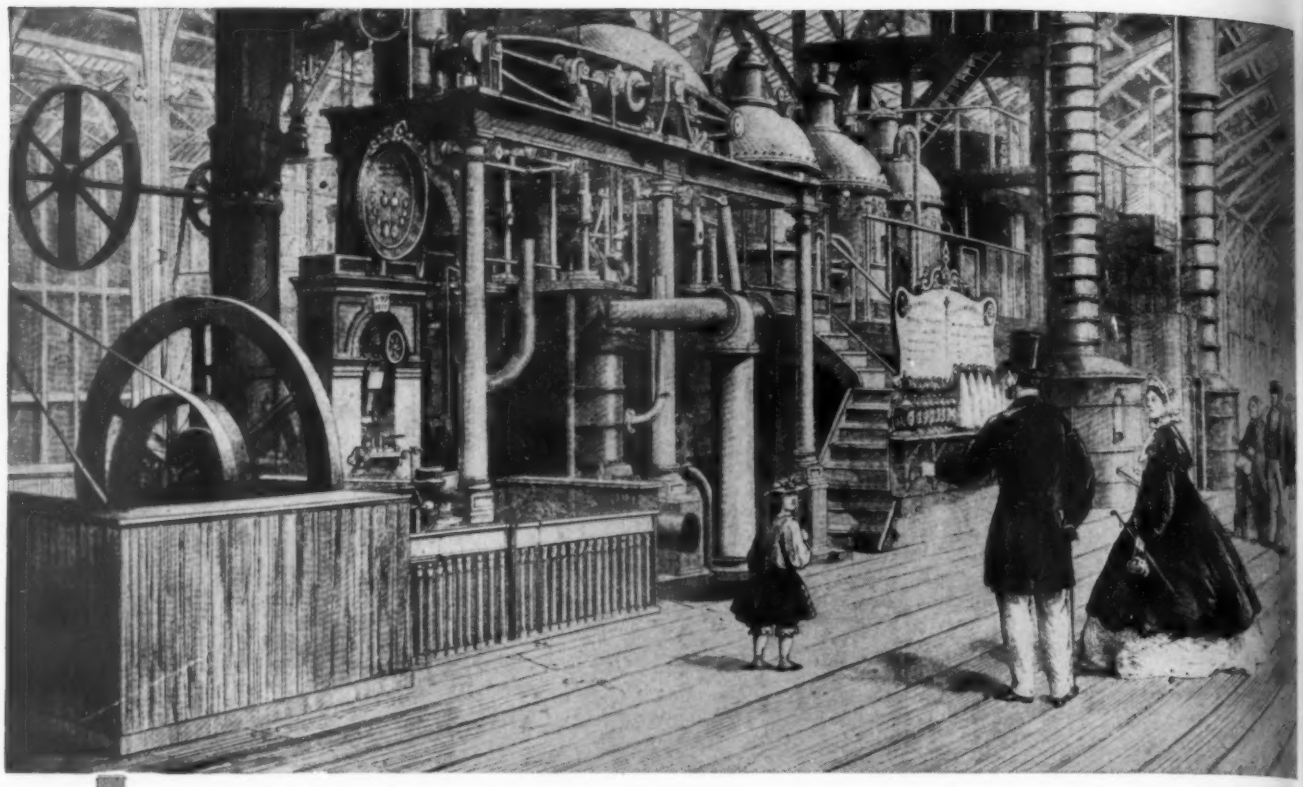


Famous Facts

Wide interest was attracted by the elaborate Sugar Refining Apparatus displayed by Messrs. Caile and Company at the London International Exhibition in 1862. Such exhibits helped immeasurably to raise the standard of living through the promotion of the industrial arts.

At the same time, Bitumastic Enamel — the first product of its kind — received wide notice for its contribution to industry as a protective coating for underwater and underground metal surfaces.

Dependable internal and external corrosion prevention for steel water and sewer pipe is assured by Bitumastic Enamel. Applied by the modern spun lining process, it affords positive protection against tuberculation with no appreciable reduction in flow capacity. It has an initial Williams and Hazen coefficient of 155 for 16-inch pipe or larger. Outstanding characteristics of Bitumastic Enamel are high viscosity, strong adherence and great flexibility.

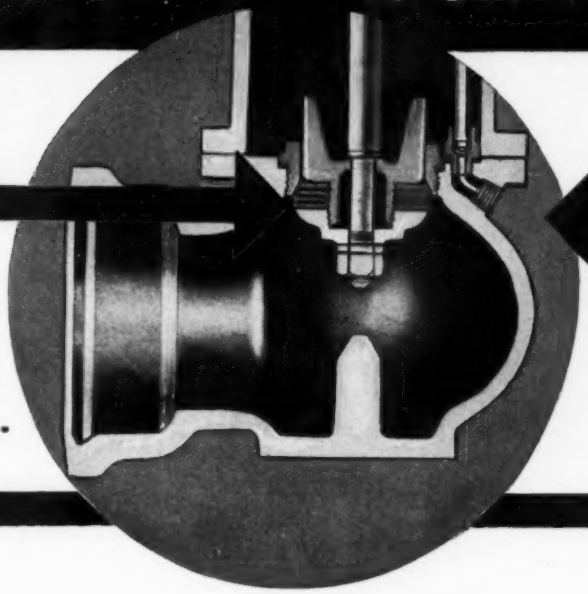
WAILES DOVE-HERMISTON

CORPORATION

WESTFIELD, NEW JERSEY

New York 4 • Philadelphia 8 • Cleveland 14 • Chicago 3 • Houston 2 • Tulsa 3 • Miami 36
San Francisco 10 • Los Angeles 1

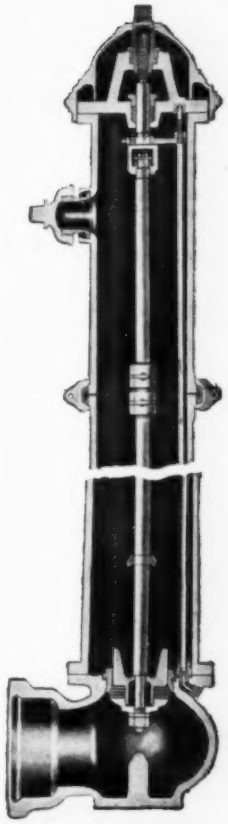
LEAKAGE THRU DRAIN *can never undermine* A SMITH HYDRANT



WHEN THE MAIN VALVE IS OPEN OR PARTIALLY OPEN . . .

THE DRAIN IS ALWAYS CLOSED

The Smith Hydrant is so designed that the drain is open *only* when the main valve is *completely* closed. Water under pressure cannot pass through the drain in the event that the main valve is improperly closed or even partially open.



Only SMITH *offers all of these* FEATURES:

1. ***Frost-proof, tapered barrel.*** Frost can't upheave a Smith Hydrant because the tapered barrel breaks the grip as the ground swells.

2. ***Low friction loss.*** Barrel cross-section exceeds valve area by 200%.

3. ***Collision protection.*** The Smith Protectop coupling confines breakage to quickly and inexpensively renewed parts.

4. ***Quick accessibility.*** All working parts easily removed and replaced without excavation.

16

FIRE HYDRANTS
GATE VALVES
CHECK VALVES
INSERTING VALVES
TAPPING SLEEVES AND VALVES
WATER SERVICE BRASS GOODS

THE A. P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

FLOOR STANDS
INDICATOR POSTS
TAPPING MACHINES
INSERTING MACHINES
PIPE CUTTING MACHINES
CORPORATION TAPPING MACHINES

A well-calked joint—a level trench without humps or hollows—a tamped backfill in all but sandy soils: these are simple fundamentals of good practise in laying cast iron pipe. Observe them and you give the pipe full opportunity to deliver the centuries of useful life built into it at the foundry. For, cast iron pipe, like all materials of construction, must be properly installed if it is to give maximum service with minimum maintenance cost. Our new 16 mm. sound motion picture, "Installing Cast Iron Pipe" is available, on loan, without charge, to water and sewage works officials, engineering schools and organizations. Address Dept. G, Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 S. Michigan Ave., Chicago 3.

CAST IRON PIPE
SERVES FOR CENTURIES

DIAMOND
Liquid
CHLORINE

available in cylinders,

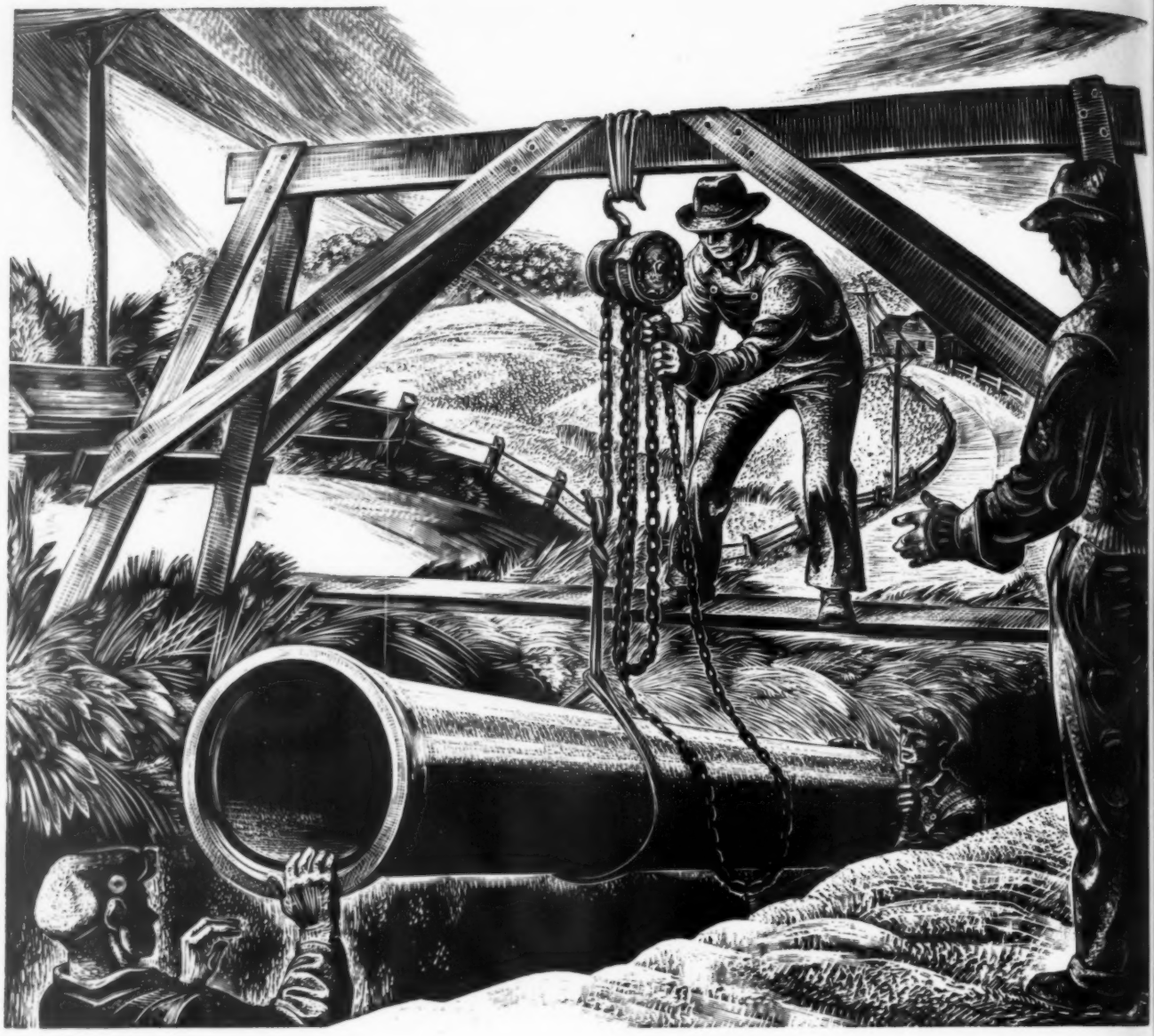
multi-unit cars, or

tank cars as required, on

a scheduled delivery basis.

DIAMOND ALKALI COMPANY

PITTSBURGH, PA., *and Everywhere*



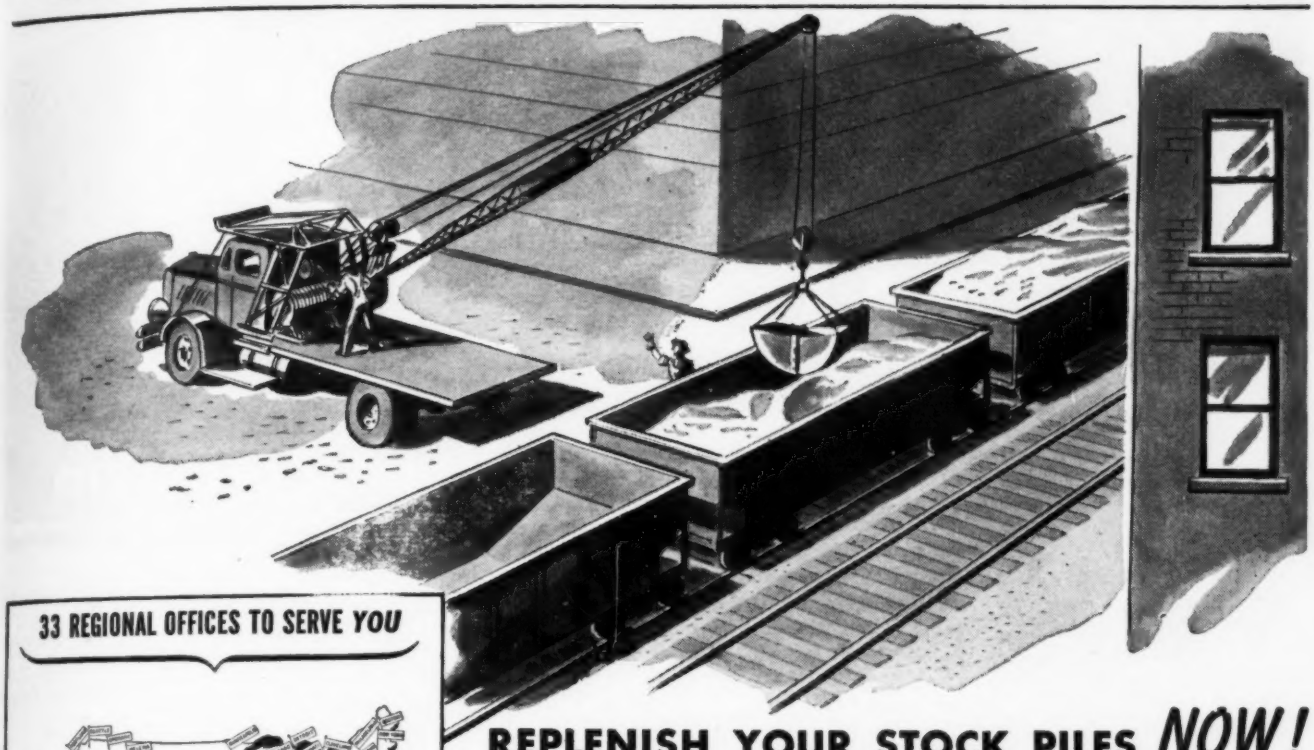
Original Woodcut by Lynd Ward

Lower away to a trench floor that's smooth and even—calk the joint thoroughly from top to bottom—tamp the backfill until well above the center of the pipe—and if it's U. S. Cast Iron pipe you're laying, you know that the line will cost little or nothing to maintain throughout a century or more of useful life. Good laying practise is co-operation by the construction crew with the pipe maker for the benefit of the taxpayer.

U.S.
cast iron
PIPE

U. S. PIPE & FOUNDRY CO.
General Offices: Burlington, N. J.
Plants and Sales Offices throughout the U. S. A.

GOVERNMENT-OWNED SURPLUS PROPERTY



REPLENISH YOUR STOCK PILES *NOW!*

INDUSTRIAL CHEMICALS

AT LOW CASH COSTS

NEVER again will there be similar opportunity to obtain standard and special specification industrial chemicals at such savings.

Included in the hundreds of available items are a few chemicals now in short supply from usual sources, and items of special interest to research chemists.

All items are ready for quick sale. Credit terms may be arranged. It will pay you to first call your War Assets Administration Regional Office when replenishing chemical stocks or planning new production. Items not available in your Region will be located for you through the special Inter-Office Product Location Service. This sales method means quick action, prompt delivery.

33 REGIONAL OFFICES TO SERVE *YOU*

HUNDREDS OF ITEMS
at unusual values

- Acetone
- Acids
- Chlorinated Paraffin (approx. 40% & 70%)
- Gas cylinders (all types)
- Hexachloroethane
- Calcium carbide
- Methyl bromide
- Dyes
- Plastic materials
- Solvents
- Sealing compounds
- Petroleum catalysts
- Activated charcoal
- Silica gel
- Calcium chloride
- Strontium oxides
- Synthetic Rubber (Neoprene)
- Dimethylaniline
- Copper naphthenate
- Synthetic & natural glues
- Printing inks (black & colors)
- and most other chemicals

EXPORTERS:
Most surplus property is available to the export market. Merchandise in short supply is withheld from export and if such items appear in this advertisement, they will be so identified by an asterisk.

FREE FACTS

Mail Coupon Today

War Assets Administration (address nearest Regional Office)

Please supply without obligation, prices, available quantities and locations of items written in below:

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(Describe item wanted)

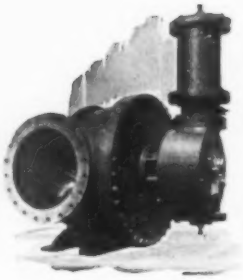
Name.....
Firm.....
Address.....
City.....Phone..... 155-4

All chemicals are subject to priority regulations. VETERANS OF WORLD WAR II are invited to be certified at the War Assets Administration Certifying Office serving their area and then to purchase the material offered herein.

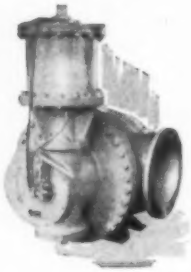
WAR ASSETS ADMINISTRATION

Offices located at: Atlanta • Birmingham • Boston • Charlotte • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Fort Worth • Helena • Houston Jacksonville • Kansas City, Mo. • Little Rock • Los Angeles • Louisville • Minneapolis • Nashville • New Orleans • New York • Oklahoma City • Omaha Philadelphia • Portland, Ore. • Richmond • St. Louis • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane

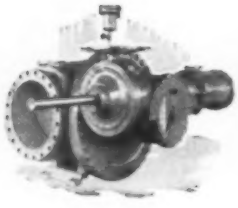
One Type VALVE for ALL Uses by Changing Control Mechanism



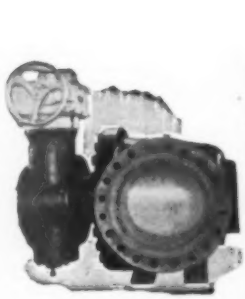
Automatic Check Valves: for use in a pump discharge line, with positive control to protect the system against surgas and back-flow.



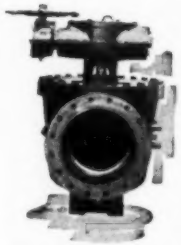
Liquid Level Control Valves: used for maintaining liquid level in a reservoir between predetermined limits.



Regulating Valves: to be used to control rate of flow by means of either pressure or velocity.



Stop Valves: for shut-off service under all conditions, the fundamental design being the same, the change being to replace the hydraulic mechanism with a motor or manual control.



ONE of the striking examples of our mastery of hydraulic problems, gained over a period of more than 72 years, is to be found in our line of Rotovalves — ***one type of valve that meets all fluid control problems,*** by simply changing the control mechanism!

The Conical Plug Valve Principle has come down through the ages unchanged, effort having been concentrated on effective means of operating the plug, and new methods of improving control. Of the literally hundreds of attempts that have been made to achieve this end, we have succeeded to a degree that is everywhere recognized by those familiar with fluid control problems.

Profit by this experience by consulting us in the development of your plans.

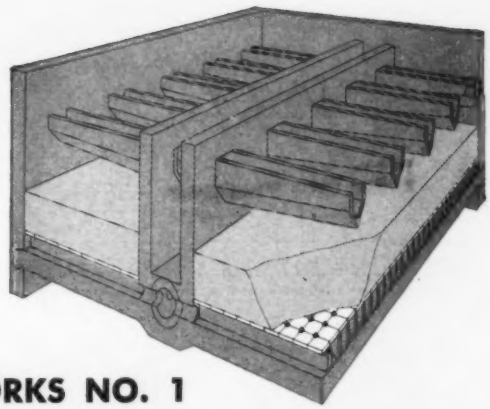
If It's Hydraulics - Put It Up to Us-

S. MORGAN SMITH COMPANY

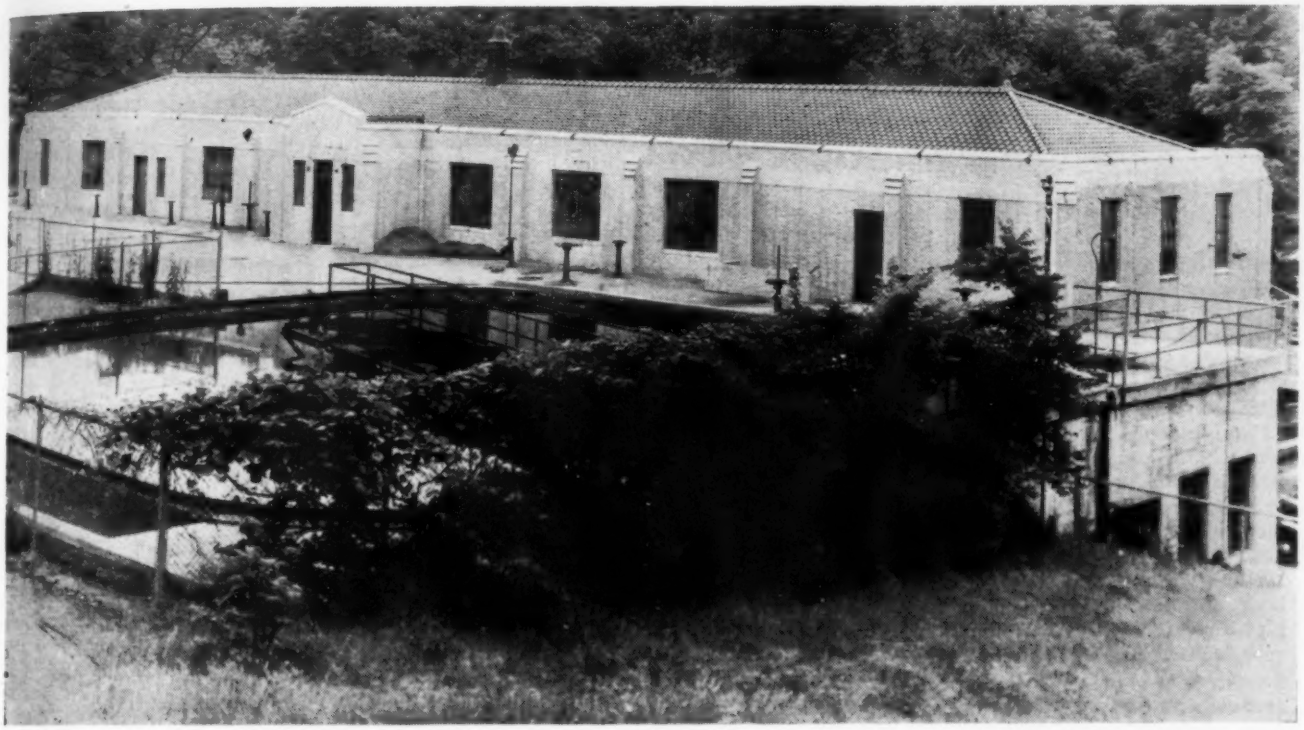
YORK - PENNSYLVANIA — U - S - A -

POWER by SMITH

Investment In TROUBLE-FREE, LOW-COST Water Filtration



BY THE WESTCHESTER JOINT WATER WORKS NO. 1



Here is still another case where the economy and efficiency of ALOXITE aluminum oxide porous underdrain plates are providing most satisfactory performance. This time it's at Mamaroneck, N. Y., the site of Westchester Joint Water Works No. 1.

The ALOXITE plates were installed over three years ago in a water filter having a bed 18′ x 24′ with a capacity of 1¼ MGD where they replace the old conventional graded gravel bed.

A quick survey of results conclusively proves that this simple, proven system lives up to all claims made for it. With graded gravel eliminated, there is no danger of mud ball formations. Nor is there a chance of the filter bed becoming upset with consequent loss of filter media. Therefore, regrading and rebuilding never present a problem.

Uniform positive backwash is complete over the entire bed. Clean filter material is much easier to maintain. And, engineers at the plant tell us there is no building up of loss of head in the underdrainage system.

Reports like this confirm the construction and operating economies derived through use of ALOXITE porous plates Whether you are interested in modernizing your present system or plan to construct a new one, we are sure you will like to know about experiences of other operators.

Let one of our technical staff tell you about these other installations. You will find his advice and suggestions helpful. Or, if you prefer, write Dept. O-96 for some practical printed information. The Carborundum Company, Refractories Division, Perth Amboy, N. J.

Underdrain Plates

BY CARBORUNDUM

TRADE MARK

"Carborundum" and "Aloxite" are registered trademarks which indicate manufacture by The Carborundum Company

R-S valve values

ISSUED PERIODICALLY BY R-S PRODUCTS CORPORATION, PHILADELPHIA 44, PA., FOR THOSE CONCERNED WITH FLOW CONTROL AND SHUT-OFF

Patented renewable replaceable rubber liner

Installing liner in valve body

Rubber liner in position

New Butterfly Valve gives 100% Complete Shut-off

Latest development in the valve field is the R-S rubber-sleeved Butterfly Valve, which for the first time in the history of Butterfly Valves gives a heavy duty 100%-effective shut-off.

The valve is currently available in sizes to handle 15 to 125 p.s.i., both using 125 lb. standard American flanges. Effective temperature range is —20° to plus 200° F.

Perfect closure is obtained from the wedge-like action of the butterfly vane closing within a one-piece flexible rubber spool which acts as a seat for the valve body and a gasket between body and pipe-flanges. A special composition of rubber and other materials has been developed to give the proper resilience while retaining long-wearing quality. A rigorously supervised test of the 125-pound valve embraced 10,000 complete movements from full open to full closed at the end of which ordeal the valve was still giving perfect shut off at 115 p.s.i.

Obviously, any ordinary use of a valve would require 10,000 closings in nothing less than a very long time. However, replacement of the rubber sleeve, if necessary, is unusually simple. After the valve body is cleared from the pipe-flanges the rubber replacement spool is folded up like an old fishing hat and thrust through the body. The flanges of the spool are patted down smoothly on the body flanges, and bolt-holes brought into alignment. "A child can operate it," as the old-time advertisers would say. The rubber spool flange takes the place of the usual flange-gaskets, a not inconsiderable economy. Patent is pending.

When Ordering Butterfly Valves . . .

1) State size of valve.
2) State type of flanges.
3) State nature of gas, liquid or other material to be controlled.
4) State line pressure.
5) State pressure loss in valve.
6) State operating temperature.
7) State rate of flow.
8) State method of control desired.
9) Get a copy of Catalog 14-B on R-S Butterfly Valves. (Write, R-S Products Corporation, Wayne Junction, Philadelphia 44, Pa.) It simplifies ordering by giving you pages of detailed diagrammatic drawings keyed to dimensional data, with illustrated descriptions of control methods.

* * *

New Tennessee and Texas Distributors

C. E. Johnson & Associate, who have handled R-S Valves in Georgia have now added Tennessee to their territory, with headquarters continuing at Atlanta.

Power Specialty Company is now the distributor for Texas and Louisiana, covering also Mobile, Alabama. Oke W. Muller is manager at headquarters in Houston, with a branch office at Corpus Christi in charge of Sam H. Young.

Mash Flow Control in Distillery

The new five stage Mash Cooler installation by Guardite Corporation for the huge Hiram Walker & Sons Distillery at Peoria, world's largest liquor distillery, is the only one of its kind in the world.

In the production of spirits, cooling of the mash is necessary after cooking. In this giant cooler an exhaust line leads from each stage to a steam jet vacuum producer in the next stage, then to a barometric condenser where cooling is accomplished by evaporation. Between each stage and the vacuum producer of the next stage the control of flow is effected.

After the first, second, and third stages, are R-S Butterfly Valves of 12-inch, 18-inch, and 24-inch sizes, respectively, operated automatically by Taylor #48 diaphragm operators and positioners; after fourth and fifth stages, are 36-inch R-S Butterfly Valves with Republic 5" by 12" cylinder operators. All are actuated by vacuum.

The success of the entire operation depends largely on the sensitive control of R-S Valves which maintain the proper vacuum without hunting or sticking.

Corrosion Chief Valve Problem

A survey by CHEMICAL & METALLURGICAL ENGINEERING in 59 plants showed that 28% of all plantmen interviewed considered corrosion problems their first concern in the maintenance of valves. In a subsequent issue of VALVE VALUES you will find a more extended discussion of valve-corrosion problems and something about how R-S Butterfly Valves are designed as an answer to the problem.

* * *

What Materials do you Pipe?

Everything that flows passes through R-S Valves. Air, other gases and vapors, catalysts, water and steam, paper-pulp, powdered fuel, sewage, soap, tars, asphalts, petroleums, synthetic rubber, acids, and many semi-solids are commonplace in R-S experience.

* * *

18" Heavy Duty R-S Butterfly Valve Type 432 for Pulp Chest Pump Isolation at Northwest Paper Company

* * *

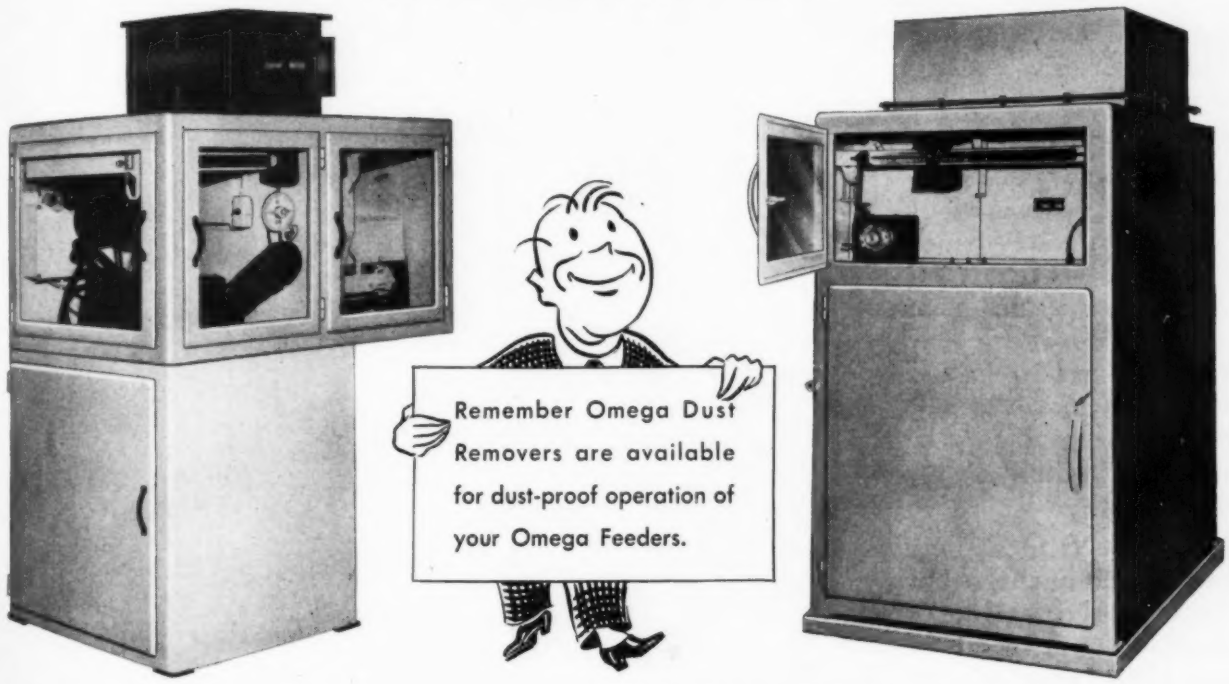
Complete R-S Valve Installation Data

Engineers like the complete dimensional data supplied for R-S Butterfly Valves. Dimensions are tabulated by standard sizes under stock types and identified by letters corresponding to detailed drawings which accompany the tables. Six full pages of R-S Products' Catalog No. 14-B (copy on request to R-S Products Corporation, Wayne Junction, Philadelphia 44, Pa.) are devoted to this basic installation data.

JMLeo J-8

Feed BY WEIGHT For Accuracy!

Omega Gravimetric Feeders are fully automatic, simple in design and reliable. They meet your most exacting chemical feeding requirements.



OMEGA BELT-TYPE GRAVIMETRIC FEEDER

Material is continuously weighed on a short conveyor belt carried on sensitive scales, with material flowing from hopper above. The feeding rate can be preset over a 100 to 1 range to deliver the exact amount required, and feeding accuracy is maintained within 2% or better. Automatic alarms warn of improper feeding. The Belt-type Gravimetric Feeder is widely used with Omega Lime Slakers.

OMEGA LOSS-IN-WEIGHT TYPE GRAVIMETRIC FEEDER

This feeder has a hopper mounted on sensitive scales and feeding action is steady, accurate and continuous, yet instantly responsive to adjustments made manually or by automatic proportional control devices. Successfully handles any dry material, including Ferrisul and similar hygroscopic material. It weighs, feeds and records with an accuracy of 1% or better. Automatic alarm devices safeguard proper operation.

Write for Bulletins

OMEGA PRODUCTS

Volumetric Feeders • Gravimetric Feeders • Solution Feeders • Lime Slaking Equipment • Bucket Elevators • Laboratory Stirrers

OMEGA MACHINE COMPANY

(Division of Builders Iron Foundry)

10 CODDING ST., PROVIDENCE 1, R. I.

OMEGA

CLAY PIPE GETS *tough* ASSIGNMENT BELOW SEA LEVEL

TRENCHES dug *below sea-level* in wet sand and shifting soil... deep cuts requiring wellpoint pumping for 90% of the trenching... tight sheeting to prevent moist sand from caving and sliding... all these were necessary during the recent installation of a 15-mile sanitary sewer system in St. Simons, one of the fabulous Golden Isles strung along the Georgia Coast.

It was a tough assignment every foot of the way... one that would have to stay "for keeps." So Vitrified Clay Pipe—62,300 feet of it—was specified to do the job. Most of this Clay Pipe was Extra-Strength to withstand the extremely high loadings caused by wet sand backfill in very deep trenches.

Clay Pipe is ideal here because it is unaffected by the corrosive action of sea water... or by any of the acids, alkalies and gases encountered in sewerage systems. It provides ageless dependability to make this a "one-time" job with no danger of future costly replacement.

Sea Water in the ground here called for the use of chemically-inert Clay Pipe. Tight sheeting was used for all trench protection. Where the subsoil was particularly loose, pipe was laid on supplementary timber foundation. Short, open trenches were used for safety in excavating, pipe laying and backfilling. Wiedeman & Singleton of Atlanta were consulting engineers. In charge of construction operations for the county were A. M. Fairly, Jr., Assistant County Engineer, and Wiley Goff, Superintendent of Public Works.

For information about Clay Pipe write to your nearest regional office.

NATIONAL CLAY PIPE MANUFACTURERS, INC.
111 W. Washington St., Chicago 2, Ill.
522 First National Bank Bldg., Atlanta 3, Ga.
571 Chamber of Commerce Bldg.,
Los Angeles 15, Calif.
1105 Huntington Bank Bldg., Columbus, O.

C-746-6

CLAY PIPE

"VAREC" approved SEDIMENT and DRIP TRAP ASSEMBLIES

THE PACE SETTER

SINCE 1928

The "VAREC" Testing Laboratory includes what is probably the largest and most up to date capacity finding apparatus in existence. It accurately determines pressure loss and flow capacities up to 500,000 cubic feet per hour.

Use of this "VAREC" flow testing apparatus is offered free of charge to our customers and friends at any time for flow testing or checking flow curves of any device.

Figure No. 230

Figure No. 232

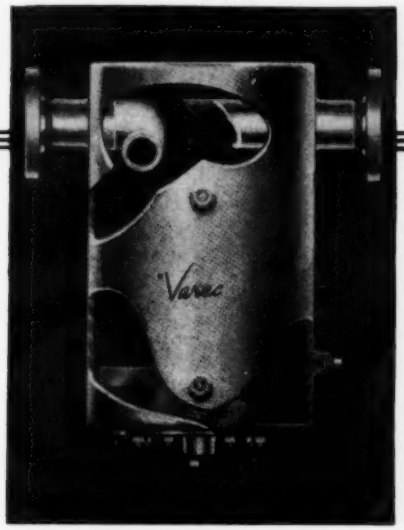


Figure No. 233

Above Figure No. 232D Manually Operated

All "VAREC" Sediment Traps are available in assembly with either automatic or manually operated "VAREC" Drip Traps. Any size or type Sediment Trap Assembly is equipped with ½" Gauge Glass Tube and ½" Drip Trap, unless otherwise specified.

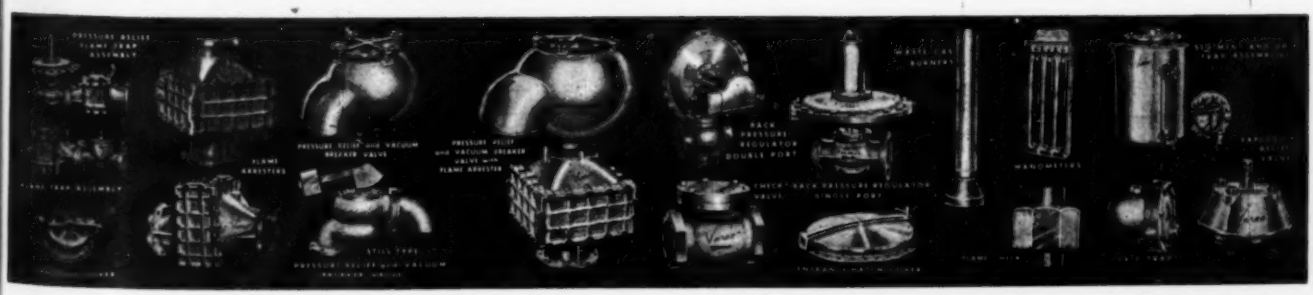
It is safe practice to install a Sediment Trap in the gas line immediately downstream of each digester, upstream of any meter or other equipment. "VAREC" offers three designs, all of which are provided with bottom drain connections and removable bottom clean-out plates.

Solids and other heavy matter are trapped by a combination of centrifugal force and pressure drop.

All types should be by-passed to facilitate cleaning.

"VAREC" Engineering Department and Laboratory will collaborate with you on any phase of Sewage Gas Control and Safety Devices in your disposal plant.

THE VAPOR RECOVERY SYSTEMS CO.
COMPTON—CALIFORNIA—U.S.A.
NEW YORK CITY—CHICAGO, ILL.—HOUSTON, TEX.—TULSA, OKLA.
Agencies Everywhere—Cable Address: VAREC
COMPTON (All Codes)
SEND FOR CATALOG S-3



FOR PROPORTIONING CHEMICALS IN SOLUTION AT CONSTANT, MANUALLY ADJUSTABLE, RATES

HEAVY DUTY MIDGET CHEM-O-FEEDER
Feeds 0-7½ GPH at pressures 0 to 85 p.s.i.

HEAVY DUTY CHEM-O-FEEDER
Feeds 0-8.3 GPH at pressures 0 to 100 p.s.i.

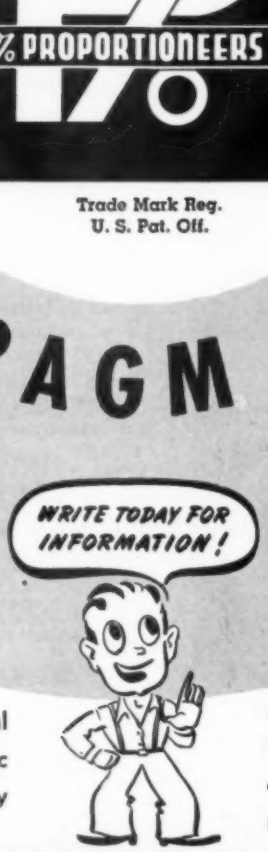
• POSITIVE DISPLACEMENT • DIAPHRAGM PUMPS •

%PROPORTIONEERS%

Trade Mark Reg.
U. S. Pat. Off.

DUPLEX CHEM-O-FEEDER
Feeds 0-15 GPH at pressures 0 to 100 p.s.i.

TRIPLEX MULTI-CONTROL
Feeds 0-22½ GPH at pressures 0 to 100 p.s.i.



All %Proportioneers% Diaphragm Chemical Pumps are equipped with "See-Thru" plastic reagent heads and successfully handle any chemical used in the waterworks field. Over 20,000 %Proportioneers% are providing precise, dependable chemical feeding in many parts of the world.

% PROPORTIONEERS, INC. %

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WATER & SEWAGE WORKS

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155 East 44th Street, New York 17, N. Y.

E. S. GILLETTE, Publisher
22 W. Maple St., Chicago 10, Ill.

COMING!

"A Look at the Record!"

While this is Ye Ed's choice of title and not the author's such could well be justified as the caption for the story of the first five years of operation of the activated sludge plant of Gary, Indiana. In the past we have on more than one occasion referred to the consistent results from the Gary Treatment Plant and the value of power recovery through operation of gas engines. The forthcoming article further emphasizes these facts, and points out the value of iron containing wastes from the steel mills of Gary, rather than the reverse. This article further emphasizes the worth of adequately designed capacity in the functioning and control of the activated sludge process and of sludge digestion, which has yielded approximately $110,000 in gas values over the 5-year period of consistent plant operation. The author is—

W. W. MATHEWS, Supt.,
Gary (Indiana) Sanitary District.

"Cathodic Protection Experience on a Steel Water Supply Main"

Is a story of maintenance experience in connection with the important 8.25 mile Bonita Pipe Line of 28 inch steel pipe serving as a transmission main for San Diego, Calif. Experiences with, and results from Cathodic protection of their 8 mgd. pipe line since 1942 are especially significant. As the result of a careful study, findings with respect to location, characteristics, methods of installation and operation, and the maintenance and renewal of anodes, make possible a number of specific recommendations which comprise a general guide of value to those considering, planning or now operating Cathodic protection systems on pipe-lines. This contribution comes from Fed. D. Pyle, Hydraulic Engr. of the San Diego Water Dept. The author of the report is—

E. C. ROGNESS, Cathodic Protection Engr.,
San Diego (Calif.) Water Department.

"Treatment of Wool Scouring Wastes at a Profit"

Now that all facts and figures can be revealed, and substantiated by plant operating results, this somewhat delayed paper will describe plant design and a new process of purifying wastes from wool-scouring plants. Originally designed as a treatment to alleviate stream pollution, it develops in the perfection of the process that through the recovery of grease of high purity, resulting from the chlorination procedure, such grease sells at a price to yield an actual profit from the operation. This article reveals plant scale results of sufficient duration to be conclusive as to both the technical aspects and economics of the process and plant operation. The authors are—

HARRY FABER and PAUL HOWARD,
The Chlorine Institute, N. Y. C. Consult. Engr., Boston.

"Straight From Our Readers"

Is another chapter on what our readers think and say about problems confronting water and sewage works operators. This particular installment is devoted to comments on "Corrosion."

"Maintenance—Its Value in Filtration Plants"

Constitutes a discussion by a former filtration plant superintendent who gives some worthy suggestions in maintenance work and how to make it systematically "click" by assigning responsibilities to plant operators in a well defined schedule of maintenance procedures regardless of the size of plant. This suggested pattern of maintenance procedure comes from—

A. E. CLARK,
Nashville, Tenn.

VOL. 93, No. 9 — SEPTEMBER, 1946

CONTENTS

Hydraulics for the Practical Water Works Man, Part III ... 335
By Robert W. Angus
Toronto, Canada

Survey of Elementary Mathematics, Part IV ... 339
By Warren K. Eglof
Niagara University, N. Y.

Sewage Works Federation Releases Toronto Program ... 342

Sludge Lagooning ... 344
By Don E. Bloodgood
Purdue University, Indiana

New Materials and Equipment for Water Works ... 349
By S. B. Morris and L. L. Camy
Los Angeles

Improving Water Plant Operation with Activated Silica ... 353
By Harold R. Hay
Philadelphia Quartz Company

The Water Supply of Eglin Field, Fla. ... 359
By Archie B. Uzzle, Jr.
Raleigh, North Carolina

Mapping the Field of Contamination Over an Ocean Sewer Outfall ... 363
By A. M. Rawn and H. K. Palmer
Los Angeles, California

Bio-Filter Operation at Keesler Field, Miss. ... 367
By R. W. Simpson
Reading, Pennsylvania

Twentieth Annual Convention Ohio Conference on Sewage Treatment ... 371

Meetings Scheduled ... Ad. Pages 100-101

Here and There with "Doc" Symons ... Ad. Page 102

Manufacturers' and Equipment News ... Ad. Page 112

Literature and Catalog Reviews ... Ad. Page 122

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HYDRAULICS FOR THE PRACTICAL WATER WORKS MAN

The Third of a Series of Articles

Hydraulic Lines in Pipes; The Venturi Meter; The Measuring Flume; Pump Suction and Discharge Pressures

By ROBERT W. ANGUS, M.E.
Consulting Engineer
TORONTO, CANADA

RETURNING to the discussion of flow in pipes, it was stated in Part 2 of this series that if at a place on a pipe line situated 6 ft. above the selected datum there is a velocity of the water of 16.04 ft. per sec. (corresponding velocity head 4 ft.) and the pressure gage reads 60 ft., the total power in the water at this point will be the same as if

TABLE I

Velocities in Pipes

Pipe size (in.)	Actual diam. (in.)	Area (sq. ft.)	Velocity ft. per sec. for 100 U. S. gal. per min.	Pipe size (in.)	Area (sq. ft.)	Velocity ft. per sec. for 1,000 U. S. gal. per min.
1	1.049	.00600	37.1	4	.0873	25.50
1¼	1.25	.00852	26.2	6	.1963	11.33
1½	1.50	.01227	18.2	8	.349	6.37
2	2.067	.0233	9.6	10	.545	4.07
3	3.068	.0513	4.3	12	.785	2.83

1000 U. S. gallons per minute = 1.44 million gallons per 24 hours. One cubic foot per second (1 c. f. s.) = 450 U. S. gallons per minute (450 g. p. m.)

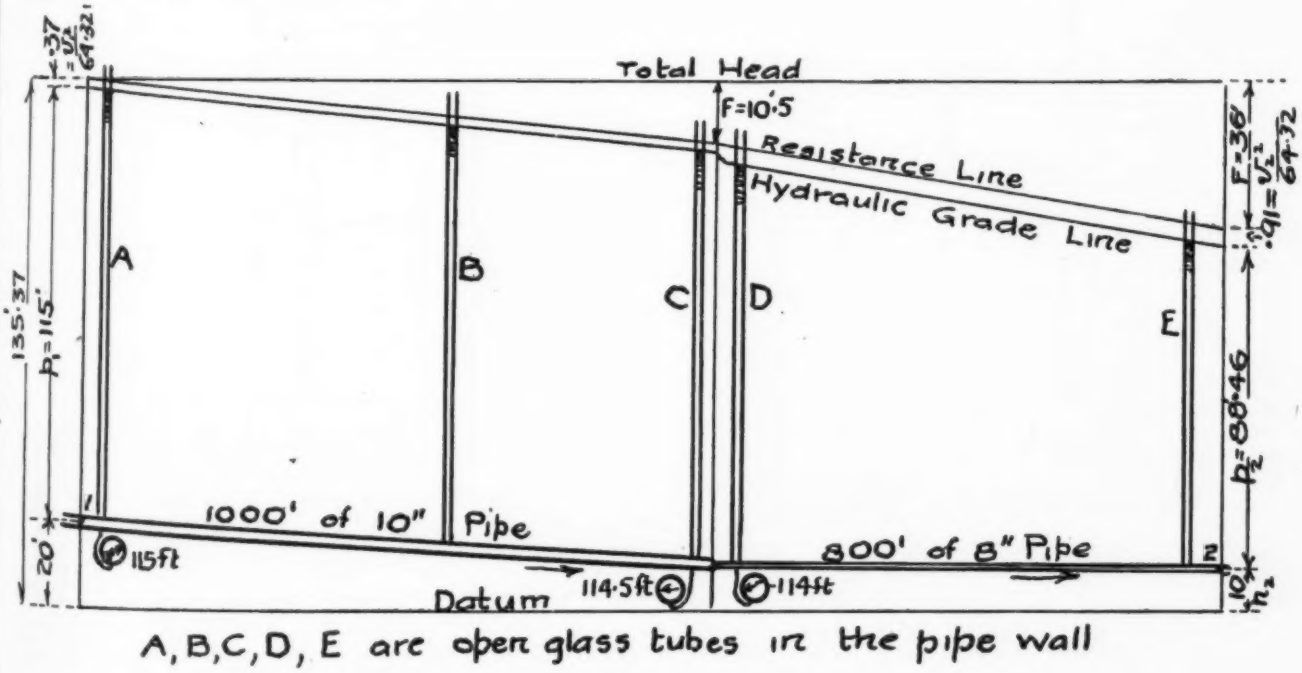

Fig. 15—Flow in a Main of Variable Size Pipes.

the water was available at a waterfall $6 + 60 + 4 = 70$ ft. high. This may be stated in the form: The power available in water flowing in a pipe, referred to any selected datum plane, is proportional to the sum of the *elevation head*, the *pressure head* and the *velocity head* at that point; consequently, if there is a pipe laid along a town or city street, where there are no branch connections and no pump or power consuming machine on the line, then if gages are attached to this line, let us say 2000 ft. apart, their pressures must be connected by the relationship: elevation head + pressure head + velocity head at the upstream gage point must equal elevation head + pressure head + velocity head + friction head (lost between them) at the second section where the lower gage is.

PRESSURES IN A PIPELINE

To illustrate this important principle, suppose the line, Fig. 15, is made up of 1000 ft. of 10 in. pipe joined to 800 ft. of 8 in. pipe, and that there is a downward slope in this distance of 10 ft. This line is discharging 1200 gal. per min. and the gage at the beginning of the 10 in. pipe reads 115 ft. (50 lbs. per sq. in. approximately), what should be the reading on the lower gage (the one at the lower end of the 8 in. pipe) if the friction loss is 10.5 ft. up to the junction and 36 ft. in the entire line.

Table I, which is again reproduced here for convenience, shows that the velocity in the 10 in. pipe is 4.89 ft. per sec. and that in the 8 in. pipe is 7.65 ft. per sec., and for these velocities the curve in Fig. 12 (see Part 2 of this series) shows the velocity heads to be 0.37 ft. and 0.91 ft., respectively. (The unusually high velocity in the 8 in. pipe was chosen to accentuate the points being discussed.) The datum has been selected 20 ft. below the gage point on the 10 in. pipe, and as the 8 in. pipe is level, the elevation heads at sections 1, 3 and 2 are 20 ft., 10 ft., and 10 ft., respectively, as marked on the drawing.

The Author*

Since the pressure head at section 1 is $p_1 = 115$ ft. and the velocity head there is 0.37 ft., the resulting total head is $20 + 115 + 0.37 = 135.37$ ft. At section 2 the elevation head is 10 ft., the velocity head is 0.91 ft., and the loss between sections 1 and 2 is given as 36 ft., which means that the gage at 2 should read $135.37 - 10 - 0.91 - 36 = 88.46$ ft., or 38.3 lbs. per sq. in. If the loss at the junction is neglected, then gages at C and D would have those readings shown on the drawing at these points. The results will, of course, be the same no matter where the datum is. The writer always finds it best to make a scale drawing of the pipe line and to plot the results as shown on Fig. 15. This can easily be done on a sheet of ruled paper with no other instruments than a divided scale and a pencil (and an eraser). If a vertical scale, such as 1/32 in. to 1 ft. and a horizontal scale such as 1/32 in. to 10 ft. is used, an ordinary rule divided in 16ths of an inch is sufficient. The method of computing the friction loss will be discussed later, but in the meantime the reader should think out how resistance losses vary, and satisfy himself that the lines are in general of the correct shape and slope, for time spent in this way is far from wasted.

In the earlier discussions of pipe flow the effect of velocity head was not considered because it was very small compared with the pressure head and neglect of it at first enabled ideas to be introduced one at a time. The *hydraulic grade line* or *hydraulic gradient* was taken as the line which was always the friction head (F) below the line of total head. Actually the hydraulic gradient is below this by the amount of the velocity head in every case. One way to

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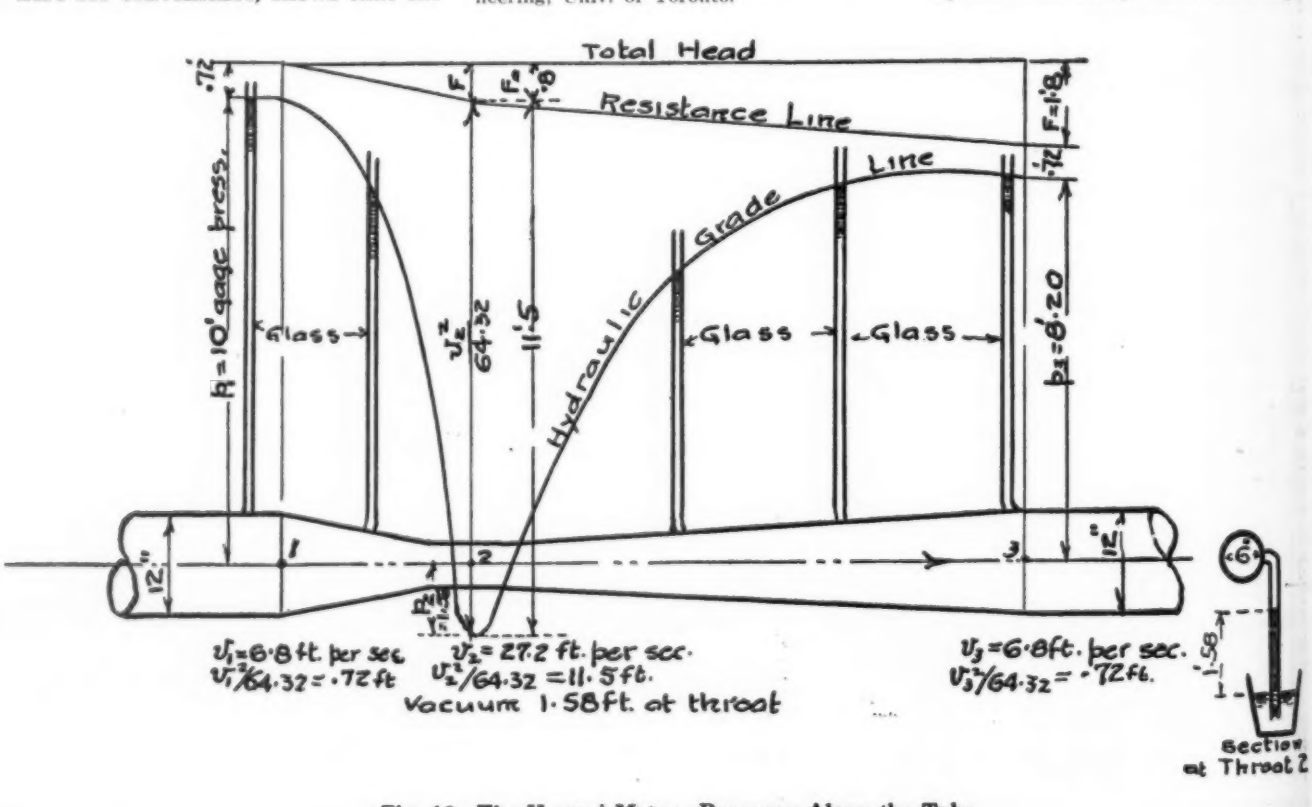

Fig. 16—The Venturi Meter—Pressures Along the Tube.

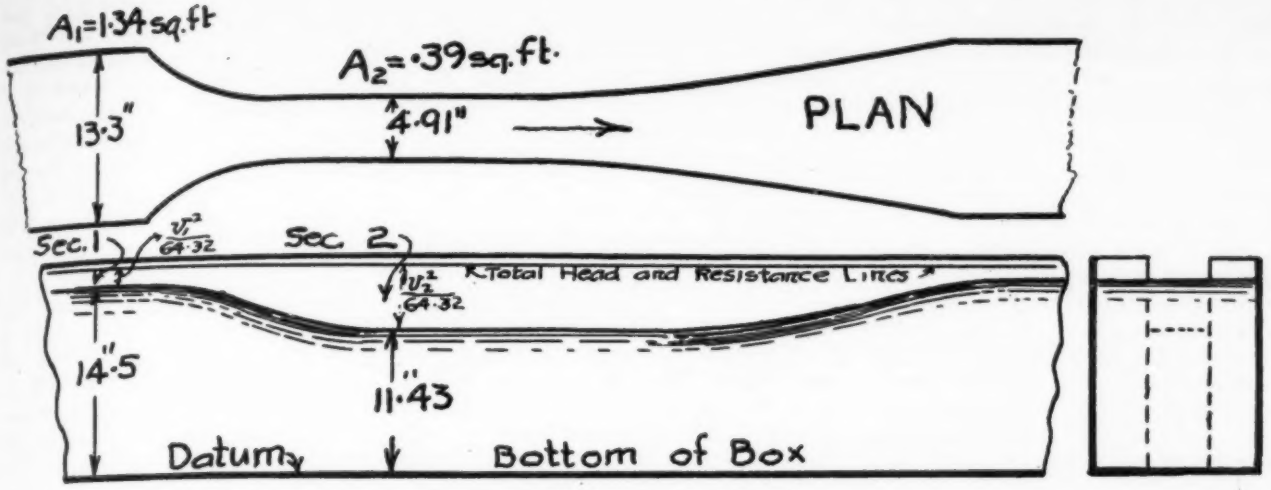

Fig. 17—The Open Measuring Flume.

picture it is to imagine a series of open topped vertical glass tubes tapped into the pipe wall as in Fig. 15 and into which the water will rise to a height corresponding to the pressure. The hydraulic gradient is the line joining the tops of these water columns, but where there is a vacuum in the line, the outer end of the glass tube must be immersed in a pail of water and the hydraulic gradient falls as far below the center of the pipe as the water in the tube stands above the water in the pail. This is shown in the next illustration.

THE VENTURI METER

As a further example we may examine the Venturi meter shown in Fig. 16. It is a horizontal 12 in. x 6 in. meter, discharging 2400 U. S. gal. per min. Table I gives the upstream and throat velocities as 6.8 and 27.2 ft. per sec., respectively, while Fig. 12 (see Part 2 of this series) gives the corresponding velocity heads as 0.72 ft. and 11.50 ft. The friction loss in these meters is always small and will be taken as 0.8 ft. up to the throat, and by taking the datum along the center of the meter all the elevation heads automatically become zero. Clearly, at the upstream end the total head is the sum of the pressure head and the velocity head, and if a gage attached there reads 10 ft., the total head will be $10 + 0.72 = 10.72$ ft. At the throat the pressure head plus 11.50 ft. plus 0.8 ft. friction loss must give 10.72 ft., or there is a negative pressure (i.e., a vacuum) of 1.58 ft. at the throat.

The various hydraulic lines for the meter are shown on Fig. 16 and are drawn for an overall loss in the meter of 1.8 ft. If the resistance lines are assumed straight as shown, it is a relatively easy and instructive task to plot the exact shape of the hydraulic grade line, because the diameter of the cone at each point is known and the velocity head at each point is readily found and plotted.

Another illustration of the effect of velocity head is shown between bridge piers where the water is lower than above and below them (where the piers themselves do not offer too much resistance) on account of the higher velocity between the piers. This fact has been employed in the design of certain measuring flumes such as the Parshall flume described on page 346 of the November, 1945, number of this magazine.

THE MEASURING FLUME

The principle of the Measuring Flume is well explained by referring to experiments described in *The Engineer*, Aug. 3, 1934. These experiments were made in connection with an open box designed as a water meter. This consisted of an open horizontal box of the shape shown on Fig. 17, the dimensions and water depths reproduced corresponding to one of the tests. As the friction loss was so small that it affected the results less than half of one per cent, it will not be taken into account, and as the datum has been taken along the bottom of the box, all elevation heads are zero. At each section the velocity is found by dividing the discharge by the area of the section in square feet, and since the velocity squared divided by 64.32 gives the velocity head, it follows that at any section the velocity head is given by $Q^2/64.32\ A^2$, where Q is the discharge and A is the area. The areas are known and it is desired to find Q from the given measurements.

In an open trough such as this, the pressure head at any point is evidently just the depth of the water at that point, so that the hydraulic gradient is always at the water surface and the velocity head, in feet, plotted above this surface will locate the resistance line. Since friction is neglected, the latter is also the line of total head, and the change in depth between sections 1 and 2 represents the difference in velocity heads between these points. But this difference in depths, and therefore of velocity heads, has been given as $14.5 - 11.43 = 3.07$ in. or 0.256 ft.

The area A_1 is $13.3 \times 14.5/144$ or 1.34 sq. ft. and that at the narrow section is $4.91 \times 11.43/144$ or 0.39 sq. ft., which is A_2. The corresponding velocity heads are then $Q^2/64.32 \times 1.34^2$ and $Q^2/64.32 \times 0.39^2$, and when these results are worked out and subtracted they give $Q^2/10.67$. This is to be set equal to 0.256 ft. and from this the calculated value of the discharge Q is 1.653 c.f.s. Since the measured discharge in this case was 1.652 c.f.s., this method of measuring is very accurate, but in the practical use of the method some care is necessary and the reader would do well to refer to the original articles mentioned above. It is an excellent illustration of the meaning of velocity head and its application.

SUCTION PIPES ON PUMPS

Another interesting case which seems to give trouble to many water works men arises in connection with centrifugal pumps. Suppose that such a pump has a vertical suction pipe leading down into the well, the pump being placed 12 feet above the water and that a vacuum gage is attached to the pipe 8 feet above the surface of the well water. What should be the reading of this gage? Applying the principles already discussed and taking the datum at the

surface of the water, the elevation head, pressure head and velocity head for a pound of water at the surface are each separately zero, so that the line of total head is at the water surface.

Where the gage is attached, the elevation head is 8 ft. and there is also the pressure head and the velocity head to be considered. There will also be some friction loss in the suction pipe up to this point, but the pipe is short, and if it has a bell-mouthed entrance without foot valve or strainer, the loss will be small. (With long, crooked pipes and sticky foot valves this suction pipe loss may be very serious.) This problem may best be studied by selecting an actual case of a pump for 2600 gal. per min. with a 10 in. suction pipe in which the velocity would be 10.6 ft. per sec. from Table I.

While it would be an improvement to put on an enlarger and increase the size of this pipe, it will still be helpful to examine the case as given, and it will be assumed that proper precautions have been taken in the design so as to keep the friction loss below the gage down to one foot. The curve on Fig. 12 shows that the velocity head for a velocity of 10.6 ft. per sec. is 1.75 ft. and, therefore, at the gage connection the elevation head of 8 ft. plus the pressure head (at present unknown), plus the velocity head of 1.75 ft., plus the friction loss of 1 ft. must equal the total head in one pound of water in the well, which is zero, as already explained. Therefore, $8 + p + 1.75 + 1 = 0$ or $p = -10.75$ ft., that is, there is a negative pressure or vacuum of 10.75 ft. at the gage. Had the pipe been enlarged to 12 in., the velocity would have been 7.37 ft. per sec. and the velocity head 0.84 ft., while the friction loss would have been about 0.5 ft., and the gage would have indicated a vacuum of 9.34 ft., found in the same way as before.

The enlargement of the suction pipe to 12 in. would mean a permanent reduction of 1.41 ft. head against which the pump had to work and would also improve the suction conditions at the pump, so that the use of the larger pipe would usually be justified.

Before leaving this case, one other matter will be considered. The pump referred to had a very high efficiency, and in addition to the 10 in. suction branch it had an 8 in. discharge branch, in which the velocity was 16.56 ft. per sec., as calculated from Table I. The corresponding velocity head is 4.25 ft., from Fig. 12, and of the total head produced by the pump $4.25 - 1.75 = 2.5$ ft. will be used up in creating this difference in velocity heads alone, and while there is no disadvantage in this so far as the pump is concerned, it may result in marked loss unless proper precaution is taken with the piping used.

To illustrate, suppose the pump lifts water from a well to a reservoir with its water surface 50 ft. above that in the well. Let the discharge piping be 8 in. and the suction piping 10 in., short and smooth and free from elbows and valves creating friction. Then the total friction losses in all the piping is about 13 ft., and the pump will have to create a net head of 63 ft. to overcome the friction and also the difference in elevation heads. Now suppose the 8 in. discharge pipe projects horizontally through the wall of the reservoir, the water entering the latter at 16.56 ft. per sec., and that the center line of the pipe is 4 ft. below the water surface. Before pumping begins, a gage on this pipe close to the reservoir will read 4 ft. pressure, and numerous experiments show that this reading will be practically unchanged at full discharge, which means that there will be a loss of head of 4.25 ft. (the velocity head) at exit from the pipe.

To prove this, the datum will be taken through the center line of the pipe and, therefore, the sum of the pressure head of 4 ft. and of the velocity head of 4.25 ft. at the gage point must equal the sum of the pressure head and the velocity head for a pound of water in the reservoir, plus the friction or other loss between the gage and the reservoir. In the reservoir at the datum level the pressure head is 4 ft. and the velocity head is zero, since the water is not flowing there, so that the total head of 8.25 ft. at the gage point equals the 4 ft. in the reservoir plus the losses between them. Thus the losses where the water leaves the pipe will be 4.25 ft., the velocity head in the pipe.

This means, of course, that the pump has to lift the water 50 ft. to overcome the difference in levels, plus $13 + 4.25 = 17.25$ ft., to overcome the friction and discharge end losses, and the total head to be pumped against is, therefore, 67.25 ft. If it is assumed that ten of the thirteen feet friction loss is in the discharge piping, then it is easy to show that the discharge gage at the pump should read 44 ft. if the gage is located 16 ft. above the well.

Obviously the losses are out of all reasonable values compared with the net lift of 50 ft. obtained and it would be most desirable to increase the sizes of the pipes. Suppose that enlargers are put on the pump flanges so that the suction and discharge lines may be increased to 12 in. and 10 in., respectively, then the velocity head in the suction pipe will fall to 0.84 ft. and that in the discharge pipe to 1.75 ft. Further, the friction losses will be about one-third their former value and may be taken as 4.3 ft.

Since the discharge end loss, corresponding to the velocity head in the discharge pipe, is now only 1.75 ft., the total losses are 6.05 ft. instead of the 17.25 ft. in the former case, and the total head to be produced by the pump is 56.05 ft. to give the net lift of 50 ft., or a saving of 11.20 ft. of head. With the larger piping the power required for pumping would be 56.05/67.25 or 83.3 per cent of that required if the smaller pipes were used, and this saving of 16.7 per cent can generally be made at relatively low cost. While the high velocities often used in the pump nozzles are not objectionable as far as the pump itself is concerned, these high velocities should always be avoided in piping, particularly on the suction side of the pump.

The method of calculating the friction losses, knowing the velocities and pipe sizes, will be taken up in the next article, but the values used in this example are reasonable. Reduction of friction losses and those corresponding to velocity heads is one of the main problems of the engineer.

(This is the third of a continuing series of articles on "Hydraulics for the Practical Water Works Man.")

Tax on Utility Bills by Municipality Held Illegal

The utility service tax of 2½ per cent placed on bills to consumers of water, gas and electricity by the City of Youngstown, Ohio, has recently been condemned by the Ohio Supreme Court as an unconstitutional act. The Court held that the State, through its tax on *gross receipts* of public utilities, had pre-empted this field of taxation.

This important decision is expected to invalidate a similar tax of 3 per cent levied by Columbus, Ohio, which has yielded the city a revenue of about $1,000,000 annually. It is understood that a few additional Ohio municipalities also have similar levies which may be considered unconstitutional.

SURVEY OF ELEMENTARY MATHEMATICS

For Water and Sewage Works Operators

Part IV

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DENSITY AND SPECIFIC GRAVITY

THE density of any object is the ratio of its mass to its volume. The mass is taken as equal to its weight.

$$D = \frac{W}{V}$$

The numerical value of the density depends upon the units of weight and volume. Three sets of units are common. They are (a) grams per milliliter, (b) pounds per cubic foot, (c) pounds per gallon. It is imperative that the physical unit be written after the numerical value. Some representative densities are:

Substance	lb./ft.³
Air	0.0795
Coal, anthracite	52-60
Coke, loose	23-32
Cork	15
Ice	57.5
Iron, wrought	480
Quartz	165
Water 32°F (0°C)	62.417
Water 62°F (16.6°C)	62.355
Water 212°F (100°C)	59.7
Dry sand	90-100

For uniform, non-porous material, the density is independent of the size and shape of the sample. For non-uniform material or when voids are present or for lump material with varying particle size, the density may fluctuate widely. A single grain of white sand if expanded to a cubic foot would weigh 165 pounds.

A cubic foot of these same sand grains would weigh about 100 pounds. $(165 - 100)/165 = 0.394$. Here the voids occupy 39.4 per cent.

The formula $D = W/V$ may be rearranged to give $V = W/D$ or $W = V \times D$.

Problem: Calculate the weight of a bar of wrought iron that is 13 ft. x 4 in. x 4 in.

$$\text{Volume (ft.}^3\text{)} = 13 \times \frac{4}{12} \times \frac{4}{12} = 1.44$$

1.44×480 lb./ft.^{3} $= 6.912$ lb.

Problem: A vertical cylindrical tank is 3 ft. in diameter. The level of oil drops 2 ft. The oil has a density of 0.774 lb./gal. What weight of oil was drawn from the tank?

Volume of oil $= \pi(3/2)^2 \times 2$
$\pi(3/2)^2 \times 2 \times 7.48 \times 0.774 = 81.8$ lb. oil

Specific Gravity

Density and specific gravity are closely related. Specific gravity is a relative density. It is obtained by dividing the density of the object by the density of some reference substance. Water is the usual reference substance. Specific gravity is a pure number and has no physical unit. It is frequently viewed as the weight of an object divided by the weight of an equal volume of water. For its exact specification, the temperatures of object and water must be given.

Sp.G. $0.842\ {}^{20°}_{4°}$ means that the liquid was at 20° C. and the water at 4° C.

$$\text{Sp.G.} = d_o/d_w \quad \text{or} \quad \text{Sp.G.} \times d_w = d_o$$

where w refers to water and o refers to the object.

Problem: The specific gravity of an oil is 0.934. What is the weight of a gallon?

$0.934 \times 8.33 = 7.78$ lb./gal.

Problem: 93.00 per cent sulphuric acid has a Sp.G. of 1.8279. Calculate (a) the weight of one liter, (b) grams of acid per liter, (c) pounds of acid per cubic foot, (d) pounds of acid per gallon, (e) gallons of the 93 per cent acid required per hour to treat a flow of 5 million gallons per day at a rate of 2 ppm.

(a) weight of 1 liter = 1000 x Sp.G.
= 1000 x 1.8279 = 1827.9 grams

(b) grams of acid per liter = 1000 x Sp.G. x %/100
= 1000 x 1.8279 x 0.93 = 1700 grams/liter

(c) lb. acid per cubic foot = Sp.G. x 62.4 x 0.93
= 106 lb./ft.³

(d) lb. acid per gallon = Sp.G. x 8.33 x 0.93
= 14.2 lb./gal.

(e) 2 ppm. = 2 x 8.34 lb. per million gallons
5/24 = million gallons per hour
5/24 x 2 x 8.34 = lb. of 100% acid per hour
5/24 x 2 x 8.34 x 1/14.2 = gallons 93 per cent acid per hour
= 0.244 gal./hr.

Problem: A clean, empty pint jar weighs 390 grams. When completely filled with water, the weight is 863 grams. When completely filled with sludge, the weight is 877 grams. What is the specific gravity of the sludge?

863 — 390 = weight of water = 473 grams

877 — 390 = weight of sludge = 487 grams

$$\text{Sp.G.} = \frac{487}{473} = 1.03$$

CHEMICAL EQUATIONS AND FORMULAS

A pure, definite chemical compound is represented by a formula. Some examples of interest to water and sewage men are:

Name	Formula
Water	H_2O
Calcium carbonate	$CaCO_3$
Calcium oxide	CaO
Calcium hydroxide	$Ca(OH)_2$
Sodium carbonate	Na_2CO_3
Carbon dioxide	CO_2
Sulphuric acid	H_2SO_4
Sodium hydroxide	$NaOH$
Aluminum oxide	Al_2O_3
Aluminum sulphate	$Al_2(SO_4)_3$
Copper sulphate	$CuSO_4 \cdot 5H_2O$

The symbols in the formulas represent definite, fixed weights of the elements. These weights are found in a Table of Atomic Weights in most reference books. The per cent composition of a pure compound may be calculated if the formula is known.

Problem: Calculate the per cent by weight of aluminum in pure Al_2O_3.

From a Table of Atomic Weights, Al = 26.97 and O=16.00

therefore $Al_2O_3 = 2 \times 26.97 + 3 \times 16.00 = 101.9$

This 101.9 = the molecular weight of Al_2O_3

This 101.9 parts of Al_2O_3 contains 2 x 26.97 parts of aluminum.

$$\frac{53.94}{101.9} \times 100 = 52.9\%$$

Frequently, commercial chemicals are not pure substances. Calculations are first made as if they were pure and then a correction is applied. If some situation required 40 lb. of pure CaO and the material available contains 85 per cent CaO, then $100/85 \times 40$=lb. actual material to be used.

Chemical Equations

A chemical change, if understood, is represented by a chemical equation.

$$\underset{74.10}{Ca(OH)_2} + \underset{98.08}{H_2SO_4} = \underset{136.1}{CaSO_4} + \underset{36.04}{2H_2O}$$

The chemical equation shows what substances disappear (on left) and what substances appear (on right). Since the symbols have definite weight meanings, the equation represents weight ratios in which

chemical substances react or are produced. The numbers above the formulas are the sums of the atomic weights for the symbols shown. The equation states that 74.10 units of weight of calcium hydroxide will neutralize 98.08 units of weight of sulphuric acid.

Problem: What weight of hydrated lime, $Ca(OH)_2$, will neutralize 40 lb. of sulphuric acid?

$$74.10/98.08 \times 40 = 30.2 \text{ lb.}$$

Frequently chemical changes in water and sewage are only partially understood. Chemical equations may be written to represent some aspects of the reactions. Calculations are made in spite of inadequate knowledge and serve as a starting point for the practical adjustment of some process. For example, the net result of adding alum to water may be formally represented by

$$\underset{342.1}{Al_2(SO_4)_3} + \underset{300.3}{3CaCO_3} + 3H_2O = 2Al(OH)_3 + \underset{3CaSO_4}{} + 3CO_2$$

This equation shows that 342.1 grains of pure anhydrous aluminum sulphate removes 300.3 grains of calcium carbonate

or $300.3/342.1 =$ grains $CaCO_3$ per grain $Al_2(SO_4)_3$

Filter alum as used is approximately 57 per cent $Al_2(SO_4)_3$

$300.3/342.1 \times 0.57 =$ grains $CaCO_3$ per grain actual alum.

1 grain per gallon $= 17.1$ ppm.

therefore $\dfrac{17.1 \times 300.3 \times 0.57}{342.1} = 8.56$ ppm. alkalinity removed per 1 grain per gallon of alum.

The actual reduction of alkalinity caused by the addition of alum is not far from this figure.

SOLUTIONS—PART A

Definitions and General Relations

A solution is a homogeneous system of variable composition. One of the two components is arbitrarily called the solute and the other the solvent. When alum is dissolved in water, the alum is the solute and the water the solvent. In practice the strength or composition of the solution must be stated. This is done by means of various general ratios.

(a) $\dfrac{\text{wt. of solute} \times 100}{\text{wt. of solution}}$

(b) $\dfrac{\text{wt. of solute}}{\text{volume of solution}}$

(c) $\dfrac{\text{wt. of solute}}{\text{wt. of solvent}}$

The general ratios take on different numerical values according to the units of weight and volume. Some examples are wt., %, lb./ft.^{3}, grams/liter, mols/liter, equivalents/liter, grains/gal., and ppm.

In the metric system with water as the solvent and for dilute solutions, the three general ratios above are numerically close together. In order to convert (b) into (a) or (c) and vice versa, the specific gravity must be known.

Problem: A solution of ammonia in water contains 28 per cent ammonia. Its specific gravity is 0.8980.

(a) Calculate lb. of ammonia per cubic foot of solution.

Water = 62.4 lb./ft.^{3}
1 ft.^{3} of solution weighs 62.4 x 0.8980 lb.
28 per cent means 28/100 lb. of ammonia per lb. of solution 62.4 x 0.8980 x 28/100 = 15.7 lb. ammonia per cubic foot.

(b) Calculate the grams of ammonia per liter of solution.

weight of 1 liter of solution = 1000 x 0.8980
1000 x 0.8980 x 28/100 = 251.4 grams ammonia per liter.

(c) Calculate the mols of ammonia per liter.

The formula for ammonia is NH_3. The atomic weights are: N = 14.008 and H = 1.008. The formula weight is 17.03. The grams per liter from (b) is 251.4.
251.4/17.03 = 14.76 mols/liter. This is the molarity of the solution. Since the formula weight in this case is also the equivalent weight, for ammonia, the 14.76 is also the normality.

(d) Calculate the grains per gallon.

Section (a) gave 15.7 lb./ft.^{3}
1 lb. = 7000 grains
1 ft.^{3} = 7.48 gallons
15.7/7.48 lb. ammonia per gallon = 2.10
2.10 x 7000 = 14,700 grains per gallon

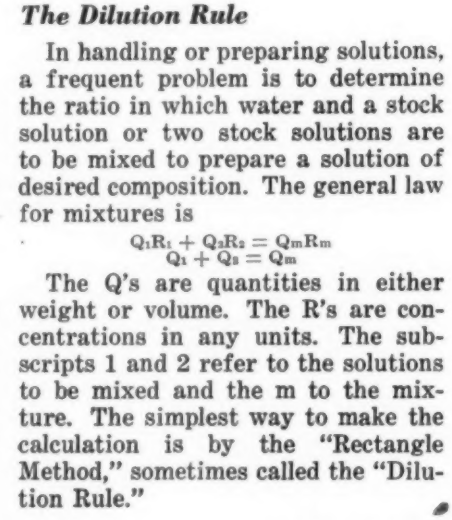
SOLUTIONS—PART B

The Dilution Rule

In handling or preparing solutions, a frequent problem is to determine the ratio in which water and a stock solution or two stock solutions are to be mixed to prepare a solution of desired composition. The general law for mixtures is

$$Q_1R_1 + Q_2R_2 = Q_mR_m$$
$$Q_1 + Q_2 = Q_m$$

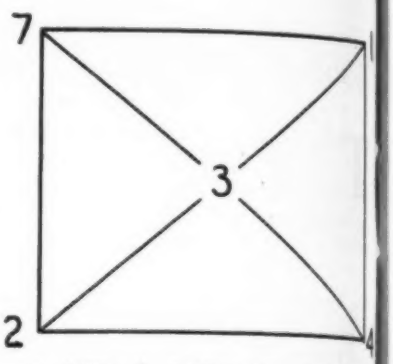
The Q's are quantities in either weight or volume. The R's are concentrations in any units. The subscripts 1 and 2 refer to the solutions to be mixed and the m to the mixture. The simplest way to make the calculation is by the "Rectangle Method," sometimes called the "Dilution Rule."



where a = the higher concentration
b = the lower concentration
c = the desired concentration

The use of this Rectangle Method is shown in the following problem.

Problem: What weights of a 2 per cent and a 7 per cent solution must be mixed to make 500 lb. of a 3 per cent solution?



1 AND 4 ARE WT. RATIOS
1+4 = 5

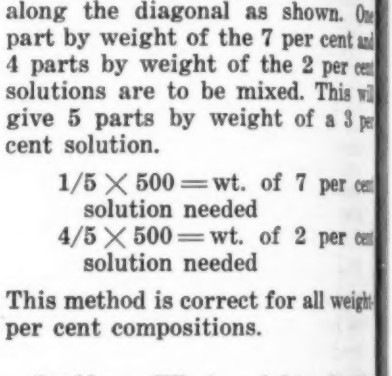
Observe where the percentages for the two stock solutions and the desired percent are placed. Subtract along the diagonal as shown. One part by weight of the 7 per cent and 4 parts by weight of the 2 per cent solutions are to be mixed. This will give 5 parts by weight of a 3 per cent solution.

$1/5 \times 500 =$ wt. of 7 per cent solution needed

$4/5 \times 500 =$ wt. of 2 per cent solution needed

This method is correct for all weight per cent compositions.

Problem: What weight of water and a 9 per cent solution must be mixed to make 500 lb. of 4 per cent solution?

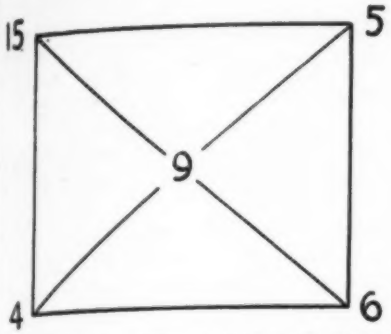


4 AND 5 ARE WT. RATIOS
4 + 5 = 9

$4/9 \times 500 = 222.2$ lb. of 9 per cent solution

$5/9 \times 500 = 277.8$ lb. of water

Problem: One solution has 15 grams/liter and another has 4 grams/liter. How much of each must be mixed to give 500 milliliters of solution containing 9 grams/liter?



5 AND 6 ARE VOL. RATIOS

5+6 = 11

$5/11 \times 500 = 227.3$ ml. of the 15 grams/liter solution

$6/11 \times 500 = 272.7$ ml. of the 4 grams/liter solution

The method is accurate for dilute solutions. It is strictly correct as long as $V_1 + V_2 = V_m$. This is sometimes not correct for concentrated solutions.

SOLUTIONS—PART C

Chemical Formulas and Equations

A pure, definite chemical substance is represented by a formula. $CaCO_3$ represents pure calcium carbonate. The chemical symbols in practical work represent definite weights of the elements. These weights are found in a table of Atomic Weights. Ca means 40.08 parts of calcium. C stands for 12.00 parts of carbon, and O represents 16.00 parts of oxygen. Since these weights are relative, any unit of weight may be used as long as the same unit is used throughout the calculation. If the symbol weights in $CaCO_3$ are added, we obtain the formula weight or molecular weight. This is 100.0 for $CaCO_3$. This is also called one "chemical unit" or one mol.

Consider the formula for pure hydrogen chloride, HCl. This represents one mol with a weight of 1.008 + 35.457 = 36.465. In this case, the weight of one mol is also called "one equivalent weight." In any chemical reaction, each equivalent weight of a reactant consumes exactly one equivalent weight of any other reactant. When hydrochloric acid reacts with calcium carbonate, the following equation gives the weight ratios.

$$CaCO_3 + 2HCl = CaCl_2 + CO_2 + H_2O$$

Since 1 HCl has just been defined as 1 equivalent weight, 2 HCl must be 2 equivalent weights. Therefore $CaCO_3$ must be two equivalent weights or one equivalent weight of $CaCO_3$ must be $\frac{1}{2}$ $CaCO_3$.

Since $NaOH + HCl = NaCl + H_2O$, it follows that 1 NaOH must be 1 equivalent weight.

Also $2NaOH + H_2SO_4 = Na_2SO_4 + 2H_2O$

and therefore 1 H_2SO_4 must be two equivalent weights. When the reaction involves a change in valence of the principle elements, the equivalent weight is found by dividing the molecular weight by the change in valence.

A table of some common chemicals used in water and sewage work laboratories follows with the equivalent weight formula:

Substance	Equivalent Weight
HCl	HCl
H_2SO_4	$\frac{1}{2}H_2SO_4$
$CaCO_3$	$\frac{1}{2}CaCO_3$
CaO	$\frac{1}{2}CaO$
$Ca(OH)_2$	$\frac{1}{2}Ca(OH)_2$
NaOH	NaOH
Na_2CO_3	$\frac{1}{2}Na_2CO_3$
$NaHCO_3$	$NaHCO_3$
$AgNO_3$	$AgNO_3$
$KMnO_4$	$1/5KMnO_4$
$H_2C_2O_4$	$\frac{1}{2}H_2C_2O_4$
$Na_2S_2O_3 5H_2O$	$Na_2S_2O_3 5H_2O$

A normal solution contains one equivalent weight in each liter of the solution. Two reacting solutions of the same normality react volume for volume.

A useful concept is the milliequivalent weight. This is 1/1000 of the equivalent weight. The normality of a solution is most usefully defined as the number of milliequivalents per milliliter.

Problem: How many ml. of 93 per cent H_2SO_4, Sp.G. 1.84, are required to make 1 liter of 0.0200 N H_2SO_4?

The equivalent wt. of sulphuric acid from the above table is $\frac{1}{2}H_2SO_4$

The molecular weight of H_2SO_4=98.02

98.02 x ½ x 0.0200 = wt. of pure acid in each liter of 0.0200 normal solution

1.00 x 1.84 x 93/100 = wt. of pure acid in 1 ml. of stock solution

$$\frac{98.02 \times \frac{1}{2} \times 0.0200}{1.84 \times 93/100} = \text{ml. of stock to be diluted to 1 liter}$$

After solutions are prepared, it is usually necessary to standardize them by some accurate method of analysis.

Problem: 0.2473 grams of Na_2CO_3 was used to standardize an unknown solution of H_2SO_4. 20.08 ml. of the acid solution was required to reach the methyl orange point. What is the normality of the acid?

The milliequivalent wt. of sodium carbonate is $Na_2CO_3/2000$

$Na_2CO_3/2000 = 0.0530$ grams

0.2473/0.0530 = milliequivalents of Na_2CO_3 taken = 4.666

4.666/20.08 = 0.2326 = normality

Problem: What volume of 0.2326 N acid must be diluted to exactly 1 liter in order that the resulting solution be exactly 0.0200 N?

When a solution is diluted with water

$V_1N_1 = V_2N_2$

$V_1 \times 0.2326 = 1000 \times 0.0200$

$V_1 = 85.98$ ml.

Problem: 100 ml. of water required 11.20 ml. of 0.0200 N acid to reach the methyl orange end-point. Calculate the alkalinity of the water in ppm. of $CaCO_3$.

mew = grams in 1 milliequivalent weight
N = normality

$$\frac{\text{ml.} \times N \times \text{mew} \times 1000}{\text{liters of sample}} = \text{ppm. } \frac{CaCO_3}{}$$

$$\frac{11.2 \times 0.0200 \times 2000 \times 1000}{0.1} = 112.1 \text{ ppm.}$$

The titer of a solution is the grams of the substance sought represented by 1 ml. of the reagent. It is calculated by multiplying the normality of the reagent used by the milliequivalent weight of the substance sought.

SOLUTIONS—PART D

Factor Solutions

When the same titration analysis is to be repeated many times, it is a convenience to adjust the strength of the reagent or to take such a sample that the calculations can be made from the burette reading by simply multiplying by 1, 10, 0.1 etc. Reagents so adjusted are called "Factor Solutions." For a fixed sample of 100 ml, this is done as follows: the general formula for ppm. is

$$\frac{\text{ml.} \times N \times \text{mew} \times 1000}{0.100} = \text{ppm.}$$

Let us specify that each ml. of acid in an alkalinity determination on 100 ml. sample shall represent 10 ppm. of $CaCO_3$

$$\frac{1 \times N \times 2000 \times 1000}{0.100} = 10 \text{ ppm. } \frac{CaCO_3}{}$$

Here N is calculated to be 0.01998 normal.

Problem: What must be the normality of a thiosulphate solution if each ml. of the solution used in the titration on 100 ml. of sample shall represent 2 ppm. of dissolved oxygen?

$$\frac{\text{ml.} \times N \times \text{mew} \times 1000}{0.1}$$

0.008 = mew of oxygen

$$\frac{1 \times N \times 0.008 \times 1000}{0.1} = 2$$

N = 0.025

SEWAGE WORKS FEDERATION RELEASES TORONTO PROGRAM

Hotel Accommodations Assured for Expected Record Attendance

THE technical program for the Annual Meeting of the Federation of Sewage Works Associations in Toronto, Canada, October 7-9, 1946, at the Royal York Hotel follows:

THE TECHNICAL PROGRAM

Monday, Oct. 7 (Forenoon)

Sewage Treatment in Toronto
William Storrie, Gore and Storrie, Consulting Engineers, Toronto
Discussor: Almon L. Fales, Metcalf and Eddy, Boston, Mass.

Environmental Sanitation in the Field of Public Health
Dr. J. T. Phair, Deputy Minister of Health for Ontario, Toronto, Ont.

Monday, Oct. 7 (Afternoon)

Characteristics and Methods for Treatment of Deinking Wastes
W. W. Hodge, Senior Fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa., and Philip F. Morgan, Research Engineer, National Council for Stream Improvement, Kalamazoo, Mich.
Discussor: William S. Wise, Chief Engineer, Connecticut State Water Comm., Hartford, Conn.

Industrial Alcohol Production from Sulphite Waste Liquor
H. G. Joseph, Superintendent, Alcohol Plant, Ontario Paper Co., Thorold, Ont.
Discussor: Professor R. G. Tyler, University of Washington, Seattle, Wash.

Standards of Stream Sanitation
H. W. Streeter, Sanitary Engineer Director, Water and Sanitation Investigations, U. S. Public Health Service, Cincinnati, Ohio
Discussor: James H. Allen, Exec. Secy., Interstate Commission on the Delaware River Basin, Philadelphia, Pa.

The Hypochlorite Process for Treatment of Wool Scouring Wastes and the Recovery of Wool Grease
Harry A. Faber, The Chlorine Institute, Inc., New York, N. Y.
Discussor: Joseph L. Campanella, Chemical Engineer, Fields Point Manufacturing Corp., Providence, R. I.

Tuesday, Oct. 8 (Forenoon)

A SYMPOSIUM ON SLUDGE DISPOSAL

Scum Control in Digesters
R. S. Rankin, The Dorr Company, Inc., Engineers, New York, N. Y.
Discussor: Harry E. Schlenz, Pacific Flush-Tank Company, Chicago, Ill.

Incineration Problems
George J. Schroepfer, Prof. of Sanitary Engineering, Univ. of Minnesota, Minneapolis, Minn.
Discussor: Mark B. Owen, Moore and Owen, Consulting Engineers, Indianapolis, Ind.

Sludge Heating
Henry J. Miles, Associate Prof. of Civil Engineering, Univ. of Southern California, Los Angeles, Calif.

Present Status of Sludge Gas Utilization
Richard H. Gould, Director, Division of Engineering and Architecture, Dept. of Public Works, New York, N. Y.
Discussor: Herbert J. Meeker, Manager, Water and Sewage Div., Worthington Pump and Machinery Corp., Harrison, N. J.

Tuesday, Oct. 8 (Afternoon)

Financing Sewage Systems and Sewage Treatment
Francis S. Friel, Albright and Friel, Inc., Consulting Engineers, Philadelphia, Pa. (Vice-Pres., F. S. W. A.)
Discussor: F. M. Veatch, Black and Veatch, Consulting Engineers, Kansas City, Mo. (Vice-Pres., A. W. W. A.)

British Developments in Sewage Purification Practice
John Hurley, General Manager, Sewage Purification Dept., Tettenhall, Wolverhampton, England. (President, Institute of Sewage Purification, England.)
Discussor: Dr. F. W. Mohlman, Director of Laboratories, The Sanitary District of Chicago, Chicago, Ill.

The Army Sewage Treatment Program
Harold A. Thomas, Jr., Assistant Prof. of Sanitary Engineering, Harvard University, Cambridge, Mass.
Discussor: Rolf Eliassen, Prof. of Sanitary Engineering, New York University, New York, N. Y.

Wednesday, Oct. 9 (Morning)

Operators' Breakfast Forum—Round Table Discussion on Operating Problems
Presiding: Harold S. Nicklin, City Engineer, Guelph, Ontario. (President of the Canadian Institute on Sewage and Sanitation.)

(Noon Adjournment)

One of the high spots on the program will be the appearance of the President of the Institute of Sewage Purification of England, Mr. John Hurley, Gen. Mgr. of the Dept. of Sewage Purification, Wolverhampton, England, who will discuss British Developments in Sewage Treatment Practice.

Another is the "Operators' Forum" on the final day under the guidance of H. S. Nicklin, City Engineer of Guelph, Ont., who is President of the Canadian Institute on Sewage and Sanitation. In this Forum will be discussed Activated Sludge Problems, Trickling Filter Problems, Sludge Disposal Problems, Sewage Chlorination, and Sewer Regulations. Starting with an "Operators' Breakfast," the entire forenoon is to be given over to the problems of plant operators and questions and answers from the floor.

SOCIAL FUNCTIONS

On Monday evening, Oct. 7th, in place of the usual Stag Smoker, there will be held the Canadian Institute Dinner, followed by a floor show. Before the show a brief address will be made by the Hon. Russell T. Kelley, Provincial Minister of Health for Ontario, who is known to be an entertaining speaker.

On Tuesday evening, Oct. 8th, will be held the customary Federation Dinner-Dance.

A feature new to the annual meetings of the Federation will be the open house or "Club Room" periods which will precede and follow both of the evening sessions, and also the two luncheons scheduled. This "Club Room" method of entertainment was originated by the Canadians in order to bring everybody together in one location for conviviality and dispense with entertaining in individual hotel rooms. This feature is made possible through the courtesy of the Sanitation Equipment Mfrs. Assn. of Canada and the Water and Sewage Works Mfrs. Assn. of the United States.

LADIES' ENTERTAINMENT

The Ladies' Entertainment Committee has planned a series of events which includes a Choral Concert on Sunday evening; a tour of the Ontario Parliament Buildings, and a reception at the home of the Lieutenant Governor of Canada; a special luncheon at the famed "Old Mill," followed by an afternoon bridge party; shopping expeditions and other sightseeing.

INSPECTION TRIPS

Toronto has under construction a new sewage treatment plant which can be visited in addition to the 10 mgd. activated sludge plant serving North Toronto. Arrangements will also permit visits to the Toronto Filtration Plants and the Municipal Incineration Plants.

EXHIBITS

The exhibit of sewage works equipment of "today and tomorrow" will emphasize post-war materials and equipment exhibited by the Canadian Sanitation Equipment Mfrs. Assn., as well as those of the member firms in the Water and Sewage Works Mfrs. Assn. of the United States.

HOTEL ACCOMMODATIONS ASSURED

Hotel accommodations may be difficult to obtain by direct application at this late date. However, it is understood that nobody who wishes to attend the Toronto meeting will go without room accommodations if a prompt request is filed with Dr. A. E. Berry, Director of Sanitary Engineering, Ontario Dept. of Health, Toronto 8, Ontario.

Chlorine Inactivation of Polio Virus

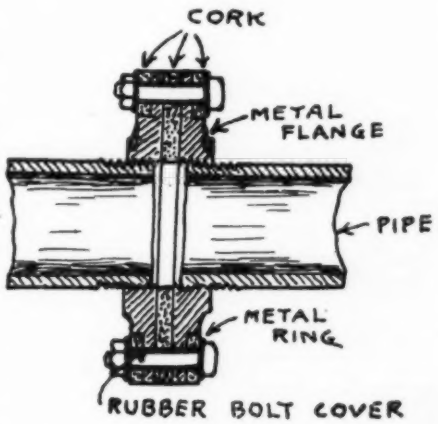
In the June 1946 issue of the *American Journal of Public Health*, Drs. G. M. Ridenour and R. S. Ingols report on the **Inactivation of Poliomyelitis Virus by "Free" Chlorine.** According to these authors, previous investigation has led to the belief that the amount of chlorine and time of contact required for disinfection against the polio virus were beyond practical limits. Hence if polio were determined to be a water-borne disease, it was not believed that chlorine would be practical for combating the virus. Messrs. Ridenour and Ingols point out that early investigations were based on the use of the orthotolidine test for determining residual chlorine. Utilizing the recently developed orthotolidine-arsenite test, which measures only "free" chlorine, the authors have concluded that the effectiveness of the free chlorine residual is independent of the type of chlorine bearing compound as long as the equivalent oxidation potential of free chlorine exists.

The research conducted by Doctors Ridenour and Ingols was carried out on mice, using the Lansing strain of poliomyelitis virus. Experiments were conducted using water treated with chlorine or chlorine dioxide generated from sodium chlorite. Results were about the same for chlorine, chlorine dioxide, or a mixture of the two, provided sufficient "free" chlorine residual was supplied. "The results from these studies show that chlorine, now in universal use for disinfection of water, can be used in amounts which will result in inactivation of poliomyelitis virus and yet produce a satisfactory and palatable water."

These studies were carried out under a grant from the National Foundation for Infantile Paralysis.

To Reduce or Eliminate Piping Noises*

Head-splitting noises are readily transmitted through metal piping—water hammer noises, mechanics' blows, vibration noises, hissing sounds, etc.—and yet little is ever done about it except, once in a while, to cover the piping. That "helps," true enough, but the noises are merely "wrapped up"—not eliminated. Metal is a more efficient transmitter of noise than is air. Water, also, is a better transmitter than air or gas.



This question therefore naturally suggests itself: "Why not stop metal pipe noises by inserting isolated joints at occasional intervals?" It can be done by following the same method that is so successfully employed in isolating machinery vibration.

Screwed flanges of ample dimensions can be used with broad and thick cork gaskets.

Cork is an excellent material for vibration isolation. The bolts, too, should be cork isolated at each end and should be completely surrounded by isolating material so that there will be no metal-to-metal contact in the joint whatever. Such a joint should prove to be leakless under high pressures and temperatures, and it should effectively stop sound waves through the metal piping.

Canvas and rubber joints are successfully used on low pressure ventilating ducts for eliminating metal duct noises. The above method would eliminate noises from high pressure piping, so why not do it?

*Contributed by W. F. Schaphorst, M.E., Newark, N. J.

SLUDGE LAGOONING

A Report Based on 20 Years of Sludge Lagooning Practice

By DON E. BLOODGOOD*
Associate Professor of Sanitary Engineering
PURDUE UNIVERSITY

IN THE February 9, 1928, issue of *Engineering News-Record*, C. K. Calvert reported upon "The Deep-Pit Sludge Digestion at Indianapolis." This method of sludge digestion had then been in use for two years. At the outset, Indianapolis expected to use "sludge lagoons" or "deep-pit sludge digestion" only as a temporary measure until some other process could be decided upon. The pilot plant tests on fertilizer production in 1931 indicated quite conclusively that this means of sludge disposal was not sufficiently lucrative to warrant competition with Milwaukee, Houston, and Pasadena in their sludge marketing enterprises.

The Indianapolis sludge lagoons met the needs for sludge disposal inasmuch as it was possible to handle all sludge produced at the Indianapolis treatment works without odor or other nuisance. There being ample area for additional deep lagoon construction, and because lagoons could be built at a relatively small cost, it seemed advisable to continue this method of handling sludge until a more suitable or economical process could be found.

Sludge lagoons have been used continuously at Indianapolis without creating nuisance for the past 20 years. It is believed that such sludge disposal economy has been the explanation, in a large part at least, for the low unit cost of sewage disposal.

Although sludge lagooning cannot be considered as a satisfactory method for sludge disposal for all installations, in many cases it can be used to meet emergencies which arise.

The Author

Sludge lagooning can be carried out successfully, but the operation must be as carefully supervised as any other part of the sewage treatment process. A sludge lagoon operated on the same basis as the old refuse dump will be just as unsatisfactory as these old dumps were, but if they are operated with common sense, plus some pride, the result will show as much improvement as the "sanitary fill" method of refuse disposal does over the old dump.

Locations of Lagoons

The lagoon area at Indianapolis is located in the flood plain between White River and Eagle Creek. Most of the lagoons have sand bottoms, as most of the top soil was used in constructing the levees forming the pits. The bottoms of the pits are only 6 to 8 feet above the ground water at minimum ground water elevations, and during flood stages the ground water is often above the pit bottoms. Although many of the lagoons have sand bottoms, there seems to be very little seepage into the ground once there is sufficient sludge in a lagoon to cover the bottom. In the early days, I am told, numerous attempts were made to loosen or scarify the bottoms between cycles of operation so that the seepage would be increased. In later years, however, the amount of drainage through the bottom of the lagoon was thought to be only minor in nature. All excess water was either allowed to overflow at the top to adjacent pits or was removed with portable pumps when a lagoon was being dewatered.

Construction of Lagoons

In constructing the lagoons the top soil which could be reached with a 20-foot boom was removed with a clam-shell bucket and caterpillar crane which piled it as a levee just wide enough at the top for a path. The levees were about 12 feet high and the natural slope assumed was about one foot vertical and one and one-half horizontal. In the early construction very little attention was given to leveling the bottom or even removing stumps of trees in some of the pits. In later years when the sludge was removed from some of these crudely constructed lagoons, considerable difficulty was encountered, so that when the WPA days

*Formerly Supt. of Sewage Treatment Works, Indianapolis, Ind.

Starting a Lagoon
Discharge line extending into lagoon.

Lagoon Partially Filled

Sludge Being Removed
Lagoon nearly clean.

came along a project was instigated for leveling the bottoms of the lagoons, removing stumps, and increasing the width of levees so that they could be used as roadways.

The smallest lagoon now in service is about 300x325 feet. The lagoon No. 8 on the map (Fig. 1) was originally three lagoons, but the north and south levees were removed to make the larger unit. Experience has shown that the area of a lagoon is not too important. The most desirable area for a single lagoon will depend upon the total amount of sludge to be disposed of at any particular plant.

In planning lagoons, where the sludge must eventually be removed, it is desirable to have the tops of the levees wide enough for truck traffic. Lagoons which must be emptied should be built with an earth ramp having a slope such that the available trucks will have no difficulty in climbing it with their maximum load. Some of the ramps at Indianapolis

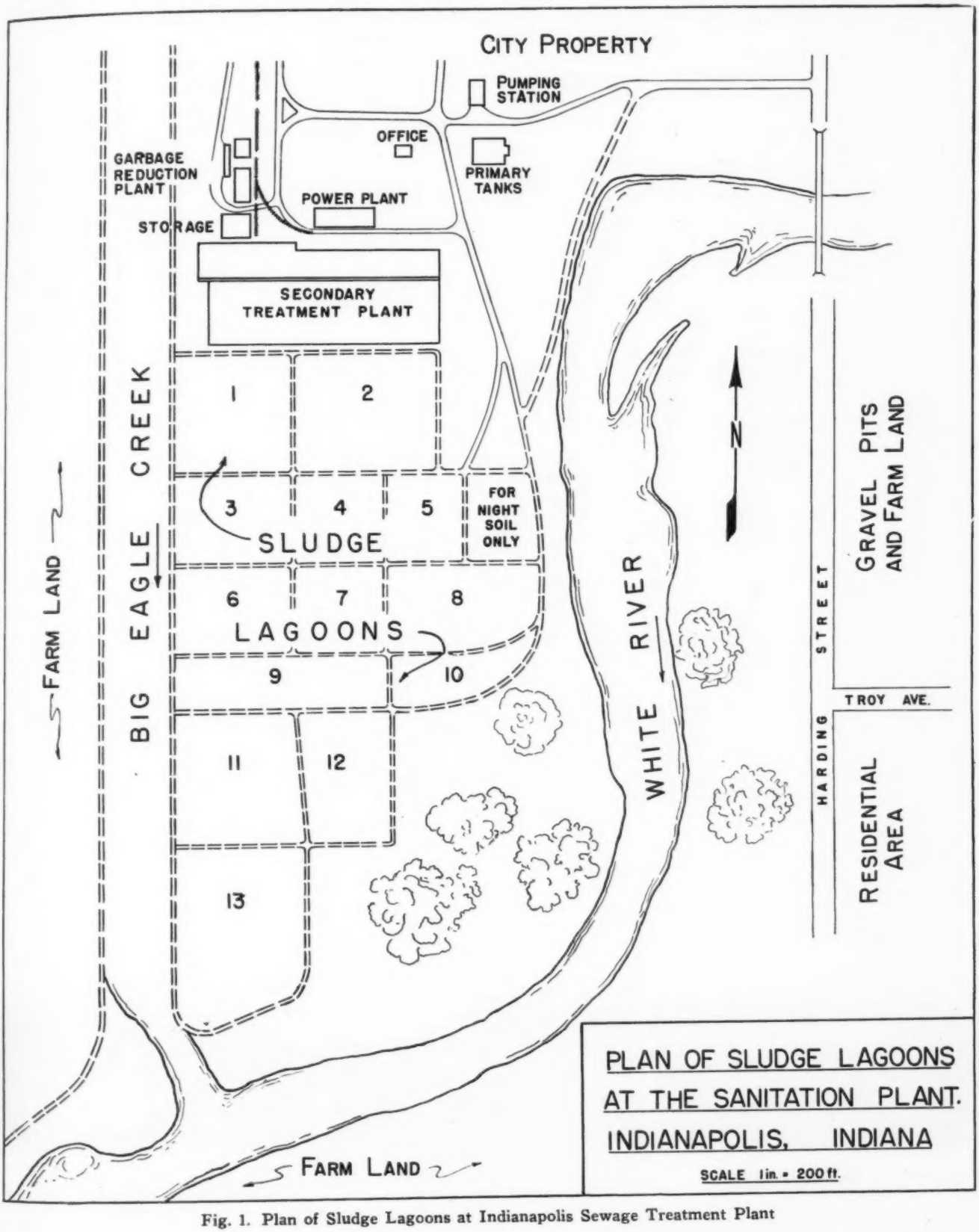


Fig. 1. Plan of Sludge Lagoons at Indianapolis Sewage Treatment Plant

have at least 15 per cent grades. Cinder roadways are maintained on the bottoms of the lagoons as the sludge removal progresses.

Sludge Distribution and Supernatant Drains

The sludge is distributed to the lagoons through steel pipes laid about three to four feet deep in the levees. From the plant to the lagoons the main piping is 12 inches in diameter. The distribution lines are 8 and 10 inches with gate valves on branches leading horizontally into each of the four corners of a lagoon wherever possible. Eighteen-inch tile is used for the valve boxes. There have been only a few instances where freezing caused any trouble with valves set in these boxes. The discharge lines beyond the valves extend into the lagoons about 20 feet beyond the face of the levees. No particular attention has ever been given to the grades on which the pipe lines have been laid; consequently, draining of the lines taken out of use was not possible. Caking of sludge in the lines, when not in use, has never been a problem. Stoppages which have occurred have usually been removed by blowing compressed air through the lines containing sludge. Appreciable coatings of grease were found in some of the lines when skimmings from the primary tanks were being disposed of by pumping them to the lagoons. The skimmings caused no particular difficulty in the lagoons, however.

A large percentage of the distribution system has been made up of second-hand steel or wrought iron pipe and it has served very well. The most recent extension to the distribution system was made with a 10-inch, 3/16-inch wall, tar coated, steel pipe with plain ends and in 40-foot lengths. The lengths of this pipe were connected by electric welds and dropped into the trench after welding.

No attempt has been made to return the supernatant to the sewage plant. Operation of the lagoons in recent years has shown that if the supernatant flows through several lagoons and finally into one containing practically no sludge, the overflow from this last lagoon will be entirely satisfactory for discharge into the receiving stream. Supernatant or sludge is drawn from one lagoon to another through pipes placed across the levees at about a depth of 3 feet. No valves are used on these lines. The flow through them can be stopped or controlled by placing a short length of plank over the end of the pipe on which the highest water head exists. The most satisfactory drainage arrangement was found to be the installation of a box at each end of these drain lines (Fig. 2). These boxes are usually approximately 2½ feet square by 5 feet deep, and anchored in the side of the levee with posts. The boxes are provided with removable boards on the outside so that the elevation of the liquid in the lagoons can be controlled.

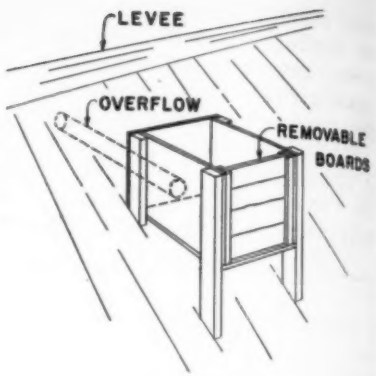


Fig. 2. Drain Box

From the experience gained over the years, it has been definitely concluded that an under-drain system is not necessary for the satisfactory operation of lagoons.

Operation and Control

The solids digested in the lagoons were primary, activated, and plain aeration sludges (Table I). No effort was ever made to thoroughly pre-mix the solids of the several sludges as they were pumped into the lagoons. At two periods lasting for several months both ground and unground garbage, amounting to the entire garbage from the city, was satisfac-

TABLE I
Character of Sludges Pumped to Lagoons

	Primary Sludge — Per Cent			Activated Sludge — Per Cent			Plain Aeration Sludge — Per Cent		
	Solids	Volatile	Nitrogen as N	Solids	Volatile	Nitrogen as N	Solids	Volatile	Nitrogen as N
1935	4.42	78.7	2.82	2.78 .41*	63.6	4.58	4.32	69.7	3.96
1936	4.84	74.8	2.88	2.78 .64*	63.9	4.80	4.58	68.7	3.79
1937	4.25	71.1	2.48	1.69 1.04*	64.0	4.30	4.11	66.2	3.26
1938	5.15	72.4	2.47	2.58 1.08*	64.2	4.59	4.45	64.8	3.40
1939	5.84	68.4	2.58	0.89*	61.6	4.61	3.82	65.3	3.31
1940	5.83	62.1	2.45	0.79	60.2	4.45	3.53	62.7	3.76
1941	6.27	68.2	2.63	0.78*	63.5	4.39	3.54	65.5	3.44
1942	7.04	69.1	2.58	0.92*	66.0	4.72	4.44	65.0	2.99
Avg. ...	5.45	70.5	2.62	2.46 0.82*	63.5	4.56	4.10	66.0	3.49

*Concentration of return sludge. Some sludge was wasted at this concentration; the remainder was concentrated to the higher figure in a sludge concentration tank.

Location of Lagoons in Relation to Plant in Background

Lagoon Being Filled
Supernatant still plentiful.

Overflow Box in Operation
Sludge and supernatant liquor at high level.

torily digested in the lagoons along with the sewage solids.

No routine laboratory control was established to aid in the operation of the lagoons. In 1933 a composite of sludge being removed from the lagoons was made and the analysis of this composite is given in Table II. This does not mean, however, that a lagoon can just be built and used as a dump for all solids and still maintain satisfactory digestion without the production of objectionable odors. Great care has always been taken in the addition of raw solids so that excessive amounts were never added in short periods of time.

It is desirable to have several lagoons into which sludges can be pumped so that one may be used for several days and then left to stand idle for a few days so that decomposition and separation of solids and liquid can take place. This procedure would not necessarily have to be followed if the lagoon were large enough so that there was a sufficient amount of digested sludge to assimilate and buffer the raw solids being added.

In starting a lagoon it is desirable to fill it with supernatant or digested sludge to a depth of three or four feet before any raw solids are added. The addition of sludge goes on for many months and an effort is made to add solids until it is impossible to add more without the sludge flowing on through to the overflow.

It has been impossible to run solids balances on the lagoons because of the overflowing from one to the other unit, and because of the difficulty in keeping records when changes from one lagoon to another take place during a pumping period. The information on the total pounds of raw solids digested in the lagoons during a sixteen-year period is given in Table III along with the lagoon volume available. It is apparent from these data that solids have been digested at the rate of about six pounds per cubic foot per year.

TABLE II

Digested Sludge Chemical Examination
Composite Sample for 1933

Analysis	Per Cent
	Dry Solids Basis
Volatile	48.3
Total organic nitrogen	2.34
Petroleum ether soluble	5.65
Phosphoric acid (P_2O_5)	1.72
	Ash Basis
HCl insoluble	23.12
SiO_2	16.85
Fe_2O_3	4.00
Al_2O_3	9.52
$CaCO_3$	23.97
$MgCO_3$	3.19
SO_4	2.68

When a lagoon has been filled completely with sludge it is "laid by" for as long a period as possible before an attempt is made to remove the sludge. It has been found that a sludge lagoon "laid by" for 18 months results in a material with a moisture content as low as 75 per cent. During the 18 months' digesting and dewatering period a portable pump is used to remove free water which will accumulate at the low points in the sludge bed.

When the sludge is ready for removal a motor crane with clamshell bucket and caterpillar treads is brought to the lagoon at the point where the ramp descends from the levee road. The operator then starts loading the sludge onto the trucks of market gardeners who haul it away for fertilizer. The sludge is usually six to eight feet deep when the unloading of the lagoon starts. By the time the shovel has worked its way to the bottom of the ramp the sludge surface has settled with a slope toward the ramp. A hole is then dug in the bottom to serve as a sump for the portable pump, which removes water leaving the sludge and also rain water.

Winter Scene of Lagoon
Surface partly frozen. Cones caused by gas.

Lagoon Being Dried Out
Sludge approximately 8 ft. deep.

Lagoon Being Dried Out
Growth of weeds on sludge surface.

Table IV is a tabulation of the yardage of sludge removed during the past several years and cost of such removal.

The removal and disposal of the sludge from the lagoons in a layout as large as that at Indianapolis is a great problem. It is entirely possible that a portable dryer and incinerator might be built which could be moved into a lagoon for the disposal of all sludge that could not be given away

TABLE III

Dry Solids Wasted to Lagoons—Pounds per Year

Year	Primary Sludge	Activated Sludge and/or Plain Aeration Sludge	Total	Average Lagoon Volume in Cu. Ft. in Service	Pounds per Cu. Ft. per Year
1926	14,515,000	12,389,000	26,904,000	4,368,000	6.15
1927	14,560,000	10,812,000	25,372,000	4,368,000	5.80
1928	13,836,000	9,942,000	23,778,000	5,562,000	4.26
1929	16,254,000	6,103,000	22,357,000	5,562,000	4.01
1930	17,242,000	10,504,000	27,746,000	5,562,000	4.98
1931	19,024,000	13,418,000	32,442,000	6,398,000	5.07
1932	16,742,000	13,706,000	29,448,000	8,306,000	3.54
1933	13,617,000	17,857,000	31,474,000	9,942,000	3.17
1934	14,983,000	20,236,000	35,219,000	9,942,000	3.54
1935	18,706,000	20,241,000 *1,590,000	40,537,000	9,942,000	4.08
1936	16,998,000	19,045,000	36,043,000	12,238,000	2.95
1937	16,239,000	22,508,000	38,747,000	14,150,000	2.74
1938	15,090,000	30,539,000	45,629,000	14,150,000	3.23
1939	16,519,000	28,585,000	45,104,000	14,150,000	3.19
1940	22,752,000	30,799,000	53,551,000	24,220,000	2.21
1941	24,695,000	30,939,000	55,634,000	24,220,000	2.30
1942	30,907,000	35,006,000	65,913,000	24,220,000	2.72

*Activated sludge.

to farmers and market gardeners. If such an arrangement could be made or the sludge could be given away or sold sufficiently fast to completely clean one lagoon per year, it would effectively decrease the volume of lagoon capacity needed to meet the requirements of a city.

General Discussion

Sludge digestion lagoons can be operated without objectionable odors providing sufficient seeding and buffering material is added when a lagoon is being started and the amount of raw solids added each day is not more than can be readily assimilated and decomposed. In the operation of lagoons it is necessary to discontinue the addition of raw solids upon the detection of the slightest objectionable odor. During the cold months great care must be exercised, as it is possible to overload the lagoons during that season without producing bad odors, but when warmer weather comes and fermentation is accelerated, odors will appear because of the overbalance of "green" solids during the period of retarded digestion.

In some instances appreciable depths of scum form on the lagoons and there seems to be no objection to this unless it is because of the weeds that may grow in the scum. It is recommended, however, that the levees be kept free of weeds insofar as possible because it creates a feeling that the lagoons are definitely a part of the sewage disposal plant rather than uncared-for dumps.

During the summer months many rat-tailed maggots grow in the lagoons. If the flies from these maggots should be a problem it is believed that they could be satisfactorily controlled by the use of light oil films or some of the newer materials used for insect control.

Lagoons of more than five feet in depth are, of course, a hazard, and if they are not sufficiently isolated they should be properly fenced.

The cost of operation of the lagoons can be seen from Table IV.

These cost figures do not include interest or depreciation and they are based upon the sewage flow that was given primary treatment. Not all of the sewage was given complete treatment during these years.

TABLE IV
Digested Sludge Removed and Cost of Operation of Lagoons

Year	Cubic Yards	Cost per Mil. Gal. of Sewage Given Primary Treatment*
1926	....	$0.96
1927	5,000	1.68
1928	10,000	0.68
1929	16,128	0.61
1930	14,336	0.58
1931	23,616	0.51
1932	12,438	0.26
1933	5,224	0.30
1934	20,208	0.23
1935	13,129	0.23
1936	25,819	1.09
1937	9,343	0.39
1938	12,198	0.20
1939	35,050	0.31
1940	25,128	0.48
1941	17,077	0.57
1942	14,878	0.42
Average		$0.56

*No capital charge, interest, or depreciation included.

Conclusions

1. A mixture of primary sludge, activated sludge, plain aeration sludge, and garbage can be satisfactorily digested without odors in open lagoons.
2. If the lagoons are used for digestion only, at least six pounds of solids can be digested per year per cubic foot of lagoon capacity. This is equivalent to 0.17 cu. ft. of lagoon capacity per pound of solids.
3. If the lagoons are used for digestion and also as dewatering beds, a capacity of 0.37 to 0.40 cubic feet per pound of raw solids per year is sufficient, providing the air-dried sludge can be removed as rapidly as it is ready for hauling.
4. Using the above capacities, it is possible to discharge a supernatant of good quality to the receiving stream.

Gladys Swope Now Chief Chemist of Allegheny County Sanitary Authority

The Allegheny County Sanitary Authority of Pittsburgh has announced the appointment of Miss H. Gladys Swope as Chief Chemist for the Authority, effective July 1. Miss Swope has resigned her position as Fellow of the Mellon Institute, where she was studying the waste disposal problems of the pulp and paper industry sponsored by the National Council of Stream Improvement, Inc.

Prior to her work at the Mellon Institute, Miss Swope was Chemist for the North Shore Sanitary District of Wake County, Illinois. Before that she had been employed as a chemist for the Sanitary District of Chicago, as Chief Chemist of the Division of Sanitation for the Kansas State Board of Health, and as a research chemist for National Aluminate Corp.

A personable lady, Gladys Swope has for several years held down the difficult job of secretary of the Division of Water, Sewage and Sanitation of the American Chemical Society, and also serves as editor of the abstract section of *Sewage Works Journal*.

New Jersey Project Reporter

Of 98 Projects Nearly Two Thirds Are Sewage Works

Under the direction of Harry P. Croft, Chief, the Bureau of Engineering and Sanitation of the N. J. State Dept. of Health, is now issuing "The Project Reporter." This Project Reporter is issued monthly except in August to anyone requesting it and it replaces the bi-monthly listings which formerly appeared in the Public Health News of N. J.

In the Project Reporter will be listed all of the engineering projects approved by the New Jersey State Board of Health at its monthly meetings. The first copy of the Project Reporter lists the projects approved in the first seven months of this year. There were 7 in Jan., 17 in Feb., 10 in Mar., 11 in April, 23 in May, 15 in June, and 15 in July.

Of these 98 projects approved, 52 were for sewage works, including five industrial waste treatment plants; 32 were for water works extensions or revisions, and 14 were for the establishment of industrial factories on watersheds within the state. Here again, as throughout the country, it appears that construction in the water and sewage field consists of approximately two sewage projects to one water project.

NEW MATERIALS AND EQUIPMENT FOR WATER WORKS*

By

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RAPID progress in the creation of new engineering materials and technical methods during the last few years has made a great impression upon the public. Many of these interesting new materials and applications of equipment and methods are now, or soon will be, available in the water works field for construction, system maintenance and operation, and for research. Enough is now known about innovations in valves, plastics, silicones, pressure welding, supervisory control systems and electronic laboratory devices to permit any material discussion of them.

Sleeve Valves

A new sleeve valve has been developed by the Pelton Water Wheel Co. of San Francisco for use as a check valve, but indications show that it can be used for free discharge services as well as an altitude control valve.

Still in the experimental stages, the peculiar construction of the valve, which has a rigid frame, permits it to be collapsed and lifted out of the framework without disturbing the pipeline itself. This overcomes the principal objection to the needle valve or Larner Johnson valve, the inside working parts of which can only be repaired after removal of the valve or a section adjacent to it.

The new valve has a movable sleeve which slides with or against the direction of the water flow. The sleeve seats against a stationary needle bulb which is held in place in the valve by ribs. The sleeve is hydraulically balanced against internal water pressure by an external balancing chamber.

Valve Actuator

A valve actuator, designed to operate valves hydraulically and put on the market by the Pacific Division of the Bendix Aviation Corp., has been specified for installation in the new steam power plant of the Los Angeles Dept. of Water and Power. Construction of the actuator is extremely simple. A reversible electric motor of comparatively small horsepower drives the oil pump in either direction and provides oil, under pressure, to be used in closing or opening the valve.

Pressure to close the valve is applied to the "close" side of the cylinder and, as the valve seats, this pressure is built up, literally pressure-sealing the valve. The pressure is then locked in the cylinder and only the reverse action will unlock it. When, for any reason, the pressure drops it is re-established automatically and immediately.

NEW CONTROL VALVE

One of the problems facing water works operators during the past four years has been the necessity of prolonging the useful life of transmission and distribution mains. The scarcity of pipeline material made it necessary to confine the use of new pipe largely to extensions for new business and the installation of new mains to meet the new business loads. This condition occasioned the use of comparatively new types of equipment as aids in deferring the replacement of mains that under normal conditions would have been considered beyond repair.

Two new types of valves have been particularly useful in solving these problems. One has extended the usefulness of a transmission main; the other reduced maintenance on booster pumping equipment in the system of the California Water Service Co., which serves areas near Los Angeles. Both valves are products of The Clayton Manufacturing Co. of Alhambra, Calif.

Automatic Pump Control

Installation of a pump control valve was decided upon in order to control pressures in a 16-in. transmission main which was being subjected to some rather high surges, from time to time causing very serious main breaks. A pressure study revealed an overall surge of 120 psi., including positive and negative surges. From a static of 165 psi., pressure increased to 220 psi. when the pump was started, settling to a running pressure of 175 psi. Upon shutting down the pump, pressure dropped to 100 psi., then, over a ten-minute surge period, gradually fell, leveling off to the 165 psi. static.

Upon installation of the pump control valve, the maximum starting surge was held to a 5-psi. increase, and the negative surge on shutting down the pump was limited to 7 psi. Operation of this valve is controlled by a solenoid-operated pilot valve which functions to open or close the main valve. The pump starts against a closed valve and, as the solenoid is energized, it actuates the pilot valve to allow the main valve to start opening. Thus, as the valve gradually opens, pump pressure is, likewise gradually, applied to the line, eliminating the surges caused by the usual fast-opening and closing check valves.

Closing action of the pump control valve is also gradual, as this operation is again controlled by the pilot valve which starts closing the main valve gradually. However, if the power should fail while the pump is running, there is no protection against surge, for a check valve assembly incorporated in the valve will close it instantly.

Unique Modulating Float Valve

The modulating float valve was primarily intended to reduce the frequency of cut-ins and cut-outs of a booster pump and so to decrease maintenance on the electrical starting equipment operating the pump. However, here, too, the valve helped eliminate surges on a transmission main. The supply to the booster pump is from a 7,200-gal. collection basin receiving water from two well pumps, one located on the premises, the other some 1,300 ft. distant. The Booster discharges into a transmission main terminating in a 220,000-

*A paper read before the 1946 Annual Conference of the Am. Water Works Assn. in St. Louis, Mo., and reproduced by permission of the Association.

gal. standpipe situated 1,300 ft. from the booster station. Operation of the two well pumps and the booster is controlled by float switches in the collection basin as well as by a high- and low-level switch on the standpipe. Thus, overall operation of the wells and the booster is controlled by system demand as reflected by the level in the standpipe, while operation of the well pumps and the booster as individual units is controlled by float switches which reflect the elevation of water in the collection basin.

Operation of the booster pump had been extremely erratic, varying from a start and stop each eight minutes to once every three hours, depending upon the system demand. Installation of the Clayton modulating float valve has extended the length of time between shutdowns to several hours, and intermittent starting and stopping has been eliminated. The only time the pump shuts down now is when the motor is de-energized through the opening of the high-level switch on the standpipe, when it is filled.

The modulating valve was installed on the discharge side of the booster pump, connected through ½-in. piping to a remote-operated, *reverse-acting* pilot valve, actuated by an ordinary float ball installed in the collection basin. As the level in the basin lowers, the float drops, causing the pilot valve to open. This in turn allows the modulating valve to begin closing, throttling the output of the pump. As the level in the basin rises, due to the throttling action of the main valve, the pilot valve starts closing, permitting the main valve to open. In effect, there is a constant pulsation of the main valve, which results in maintaining a fairly constant level in the collection basin. When the level remains constant, the valve remains in a fixed position, allowing the pump to discharge at a uniform rate.

The two types of valve have been very satisfactory and have served to decrease the maintenance expenditures of the California Water Service Co. considerably, prolonging the usefulness of transmission mains and pumping equipment.

Plastics

Improvements in the field of protective coatings offer many possibilities for improvements in water works practice. For example, there are being developed many interesting new synthetic thermosetting and thermoplastic materials which appear to have very good bond to metal, good resistance to abrasion and excellent resistance to conditions of exposure common in water works operations. These products have not been thoroughly tested in practice, but they are promising and may yet eliminate many vexing corrosion problems with steel water lines, valves, fire hydrants, pumps, pressure regulators and storage tanks.

Present procedure involves thorough cleaning of the article to be protected, then application of the plastic resin coating by brushing, dipping or spraying. After evaporation of the solvents used as a vehicle, the coating must be cured by baking at a time and temperature dependent upon the properties of the resin used.

The finished coating has a smooth, hard surface, sufficiently flexible to dent rather than shatter and sufficiently resilient to resist considerable abrasion. Proper curing is required to obtain these properties and special equipment must be designed to make this process practicable. Portable heating devices making use of infra-red reflecting lamps seem promising, both for plant and field application.

Silicones

Chemical research has developed a family of materials called silicones. These include fluids for high- and low-temperature use having little viscosity change, chemically resistant greases, insulating resins, lubricants and rubber-like substances, in which silicon is used to replace the carbon of the usual compounds. The resulting products are said to have many properties that are superior for special purposes to those of the standard organic products. For example, it is possible to build electric motors insulated with silicone products that will operate safely at temperatures as high as 350° F., thus permitting lighter weight equipment. Silicone greases which will dependably lubricate motors operating at such temperatures are also serviceable at —4° F. Silicon varnishes and lacquers will not char at 350° F. and are serviceable at even higher temperatures. Silicon fluids are available for use in hydraulic systems for temperature conditions approaching —70° F.

Pressure Welding

A new method of field-welding steel pipelines, called "Pressure Welding," has been employed for some time in the oil industry, notably in the "Big Inch" and "Little Inch" pipelines. Although at the present time this method is not applicable for steel water lines, the authors feel that the procedure should be called to the attention of water works men.

In pressure welding, no welding rod is required. It differs fundamentally from fusion welding in that the parts to be joined are not heated to fusion temperature but are forced together under a controlled application of heat and pressure. Assembling and welding of steel pipe by this method is done aboveground. The ends of the pipe are properly prepared and ground square for a butt weld. Pressure welding clamps are placed around the two ends of pipe to be joined and a circular oxy-acetylene welding head is lighted. When the correct temperature is attained, the ends of the pipe are brought together by means of the pressure welding clamps, and a forging and welding action is completed within a few seconds. Tensile, free bend and nick break tests indicate that the resulting weld is excellent.

Supervisory Control

Supervisory control of pumping plants and valves will be utilized to a greater extent in the water works field. As the term is generally applied, supervisory control includes both telemetering (which is the electrical means for measuring the state of a substance or the status of mechanical equipment, transmitting the result to a distant station and there indicating or recording it) and remote control to alter the situation if necessary.

Though supervisory control is not new, having been used successfully in the power supply industry for approximately 25 years for central station control, it has only recently found widespread favor in other industries. Two recent examples of the application of supervisory control are its use in the control of all processes in a large steel mill and in the control of pumping plants along a 1,261-mile pipeline delivering different petroleum products to as many as seventeen points over single, paralleled and branched pipes of various sizes.

Considerations favoring supervisory control are the delegation of responsibility for proper operations to a single individual, thus eliminating errors due to confusion or misunderstanding; the increase in speed of operation, particularly in the closing of valves when breaks occur in major trunk lines; and, if actuated by recently developed ultra-high frequency equipment, the increased reliability when standard transportation and communication facilities are disrupted by earth-

The New Clayton Pump Control Valves

(Developed for, and installed, at the East Los Angeles plant of the California Water Service Co. A picture of the new Modulating Float Valve installation is not available at this writing.)

quake, flood, tornado or other major disaster.

Assuming supervisory control to be advisable in some systems, it is well to consider automatic control of pumping plants and valves in the system, either as an alternative or a supplement to a supervisory system. The usual features incorporated in the Los Angeles Dept. of Water and Power's thirty-three fully automatic pumping plants include automatic priming when suction lift occurs; blocking of controls if there is no suction on a positive suction line; automatic starting, in most instances by pressure switches located in the plant; automatic selection of units to rotate service of the units in any one system; automatic lockout of a unit if there is no flow after a predetermined time, and many other features. In several instances automatic controls have been installed on valves to regulate the amount of flow into branch lines, depending upon water level in a reservoir or pressure conditions in the trunk line.

Usually it is advisable to consider a combination of supervisory and automatic controls, determining to what extent such controls should be carried in an extensive water system. Telemeter recording of water levels in major reservoirs and water pressure at strategic locations in major trunk lines would be highly advantageous in any system of operation, and the means used to transmit this signal can also be designed to operate electrically driven gates or valves. Perhaps major pumping plants should be controlled from the dispatching office; it would then be advisable to incorporate all of the automatic features previously mentioned, with the addition of hot-bearing lockout. The automatic controls could be arranged to cut in upon failure of the supervisory system or at the will of the operator.

Various electromechanical means for both telemetering and control have been on the market for many years, and a new type of electronic control is now available. Various means of signal communication have been employed, including direct wire, carrier current, leased telephone company channels and radio. No doubt some form of radar equipment will be available in a short time. To operate such equipment at locations where no power is available, it would be necessary to install some form of power generation; perhaps the most satisfactory would be a battery supply, kept charged by an automatic engine generator.

Testing Devices

New materials and equipment for the research laboratory include the new electronic devices now becoming available, which will provide more accurate determination of stresses, defects, pressure surges and other conditions about which too little is now known.

One device used for the measurement of strains in structures depends upon the variation in electrical resistance of certain very small diameter alloy wires according to the amount that they are stretched or compressed. These fine wires are cemented to the structures to be

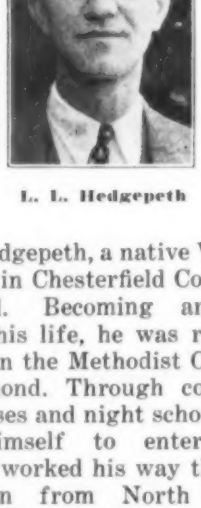
stressed and connections are made to one side of a balanced Wheatstone bridge. As the structure is stressed and a strain is produced, it is necessary to change the resistance on the other side of the Wheatstone bridge to restore a balanced condition. It is possible to calibrate the change in resistance required for balance in terms of strain for any given gage. Studies indicate that this gage, when properly operated, is accurate to 0.00001 in., or approximately 300 psi. for steel members. This device can be used with a cathode-ray oscillograph to determine rapidly changing strains such as might result from water hammer, pressure-regulator operation or other conditions which cannot be satisfactorily determined with conventional strain gages due to the inertia of the moving parts.

A device is also available for indicating almost instantaneously the changes in pressure in a water distribution system which may result from improper operation of pumps, valves, regulators or other mechanical equipment. The gage depends for its operation on the change in electrical resistance of certain salt crystals under varying pressures. This change in resistance causes a change in the voltage drop impressed across an oscillograph and results in a visual picture of the pressure wave on the oscillograph screen. Such a device has negligible mechanical inertia and can indicate pressure changes occurring at frequencies as high as 100 kc.

A recently developed method for rapidly detecting flaws in ferrous metals may be applied to the detection of hidden cracks or flaws in pipes, tanks, chlorine cylinders and other water works materials. Such flaws in pipes are particularly difficult to detect because of the cement linings and bituminous coatings which prevent visual location of small defects. The device mentioned makes use of an oscillograph to indicate any variation in magnetic flux caused by change in the character of material being inspected. A crack or flaw in the pipe wall changes its magnetic properties enough to be indicated on the oscillograph screen. Due to the press of war work, sufficient research has not been conducted to indicate how satisfactory this device will be in the inspection of water works materials, but plans are now being made to study this problem.

Hedgepeth to Head Va. Water Control Board

L. L. Hedgepeth, technical assistant to the vice-president of the Pennsylvania Salt Mfg. Co., has been chosen Executive Director of the newly created Water Control Board of Virginia, charged with the administration and enforcement of the recently enacted State Water Control Law of Virginia.



L. L. Hedgepeth

Mr. Hedgepeth, a native Virginian, was born in Chesterfield County near Richmond. Becoming an orphan early in his life, he was raised and schooled in the Methodist Orphanage in Richmond. Through correspondence courses and night school, he prepared himself to enter college, where he worked his way through to graduation from North Carolina State College in 1925 as a chemist. He went to work for the N. C. State Dept. of Health as assistant sanitary engineer and later was employed by Wm. C. Olsen, Consulting Engineer of Raleigh, N. C. After that he operated the water purification plants of Elizabeth City, Thomasville and Southern Penio, N. C. For a time he was also chemist in charge of the North Carolina Stream Pollution Investigations Laboratory.

During World War I Mr. Hedgepeth served in the Richmond Grays, from which he received his discharge as a sergeant in 1918.

For the past 17 years he has been employed in various capacities in the Pennsylvania Salt Mfg. Co., which operates eight plants in America which produce 189 chemicals and chemical products. In the water and sewage field he became best known as Director of Technical Service for Penn. Salt. During his employment with this company, Mr. Hedgepeth became known as its "technical missionary," serving as a member of many technical committees and as chairman of a number. The Am. Water Works Assn. voted him the Fuller Award for his contribution to the science of water treatment. In recognition of his services to his community, the new laboratory of the Media, Pa., filtration plant was dedicated the Hedgepeth Laboratory.

In announcing the appointment of Mr. Hedgepeth as Executive Director, E. Blackburn Moore, chairman of the Board, stated that Mr. Hedgepeth will devote only a part of his time to the new position and will continue to serve the Penna. Salt Co. during a transition period to December 1st, at which time he will take over the executive directorship on a full time basis. Mr. Hedgepeth's new work will bring him into very close cooperation with Richard Messer, Chief Engineer of the Va. State Dept. of Health, since the work of the Water Control Board and the Engineering Division of the State Dept. of Health is to be interlocking in most respects.

Westchester Water Works Conference Holds 6th Meeting

The Westchester Water Works Conference (Westchester County, N. Y.) formed as a mutual aid group prior to the war, has held its 6th annual meeting and outing at Schmidt's Farm in Greenburgh, N. Y. James C. Harding, Commissioner of Public Works of Westchester County, as chairman of the conference, presided at the meeting attended by 157 members and guests.

The following members were elected as Board of Directors for the next three years: Arthur L. Richards, Executive Engineer, Village of Larchmont; Charles Doddo, Water Supt., New Castle Water Distr. No. 1, and James M. FitzGibbons, Supt., Water Dept., Yonkers, N. Y. Most of the water officials of the 62 water districts in the county attended the meeting. There are 110 members in the Conference.

Cleveland to Spend $44,000,000 on Water and Sewage Works

A capital improvement program for Cleveland, Ohio, totaling $133,000,000 for the next six years, has been approved after the first public hearing.

Specific projects include $30,000,000 for water works betterments and $14,000,000 for sewerage improvements.

These expenditures will require no increase in real estate taxes, the program to be financed largely from utility revenues.

IMPROVING WATER PLANT OPERATION WITH ACTIVATED SILICA

Part I. Conventional Flocculation and Sedimentation Plants

By HAROLD R. HAY
Chemical Department
PHILADELPHIA QUARTZ COMPANY

DURING the past several years there have been two parallel developments of major importance in coagulation as it is applied to water treatment. Engineers and chemists both have worked toward obtaining higher quality water at production rates much above those formerly regarded as safe practice. A correlation of advanced design and improved chemical treatment has produced effects of mutual benefit so outstanding as to indicate rapid abandonment of low rate operation.

That recognition of this trend is becoming strong in the ranks of the American Water Works Association is evidenced by the action of the Purification Division at the 1946 meeting in St. Louis. The name of the "Committee on Permissible Loadings and Capacity of Water Treatment Plants" was criticized for its negative character, and changed to "Committee on Loadings and Capacity of Water Treatment Processes." Acknowledgment was thereby made that not only new types of equipment but also new chemical processes must be considered for the values that they possess in providing better quality water at lower cost.

Never before have new ideas so broadly challenged the older practices in water purification. In the equipment field, upflow units successfully combine the functions of floc conditioning, sedimentation, and sludge removal. For some water uses, these units also eliminate the need for filtration. For industrial plants, new types of filters are manufactured which are claimed to be effective without advance sedimentation; all of the floc passes on to the filter, which is provided with an automatic backwash. Other new filtration procedures, suitable for clarifying small volumes of water, avoid coagulation completely and reduce chemical treatment to disinfection and odor removal.

In contrast with the basic departures involved in the above mentioned developments, design changes in conventional floc conditioning and settling basins are more evolutionary. Higher velocity chemical mixing and conditioning are used as a result of more intelligent chemical application. Some new devices for flocculation and others for the distribution of water into the sedimentation basin are available. Sludge removal is improved. Conventional filter practices are yielding to new filter design, to higher rates through coarser media, and to the use of surface washing devices.

In comparing the new and the old types of equipment, it is important that each of the various designs be considered in conjunction with the best chemical treatment practices. New coagulation methods can greatly improve the efficiency of conventional floc conditioning, sedimentation, and filtration if some slight modifications of design are provided by the consulting engineer, equipment manufacturer, or plant superintendent. In Part II of this paper it will be shown that the new coagulation methods can correct many water conditions that otherwise prevent upflow equipment from performing at full engineering efficiency.

It is increasingly recognized that both an optimum chemical balance in the water and good engineering design are required for maximum coagulation efficiency and economy. With present design practices it is sometimes impossible to apply improved chemical treatment.

The Author

Following Mr. Hay's reference article on "Colloidal Silica as an Aid in Floc Formation" in the June, 1944, number of *Water Works & Sewerage*, and his more recent "New Concept of Coagulation" (*Water & Sewage Works, June*, 1946), it has seemed logical to ask Mr. Hay to prepare a series of articles, reviewing the basic concepts of activated silica and its use as an aid in water treatment. The first of three articles appears herewith and discusses activated silica in conventional flocculation and sedimentation plants. The second will discuss its use in upflow type coagulation basins, and the third will discuss the important role of activated silica in cold water flocculation.—The Editors.

Advancements in Chemical Treatment

In such fields as boiler water treatment, disinfection, and corrosion control, chemistry is being recognized as more fruitful for current study than engineering. Within the past few years, this recognition has produced processes for deionization, methods for disinfection and odor removal using chlorine dioxide, and recommendations for the proper use of sodium silicate and the polyphosphates for corrosion control and scale prevention. In coagulation, the so-called "electronic" water clarifier is more of an engineering development than chemical, although it demonstrates the possibilities in departing from customary coagulating chemicals.

Activated Silica

The chemical development that has affected the largest number of phases of water plant design and operation is "activated silica." Its use is now widely established with excellent service records of several years' duration. The original claims, while spectacular, have been repeatedly verified and new values determined. The recent literature contains a number of statements of approbation by the users.

Reference by A. W. Rumsey[1] to the "magical properties" of activated silica would appear fully substantiated by L. L. Klinger,[2] who compiled the benefits of using activated silica with alum in the following

manner: "The application of activated silica produces more effective coagulation in both warm and cold water periods; increases floc size and densifies floc; reduces the necessary alum and alkali consumption; broadens the effective pH range of treatment; increases the length of filter runs; buffers sudden chemical changes of raw water characteristics; reduces the raw water color by better than 90 per cent; improves filtered water quality generally and reduces turbidity; prevents "after precipitation" of alum during cold water periods when alum reacts slowly; and decreases dissolved silica."

One familiar with coagulation troubles will promptly find an answer for an unusual number of them among the values of activated silica as described by Klinger. Increasing plant capacity,[3] the clarification of difficult types of turbidity,[1] and improved softening[4] are additional well-established assets.

With repeated plant scale successes it has been shown that the activated silica can benefit floc formation in nearly all water supplies, that the methods are not too complicated for use by the operators, and that there is a reduction rather than an increase in the silica content of the finished water when used with alum. Reasons for early failures have been determined as ones associated with plant design factors not currently employed or, at least, not in keeping with the present trend. Objections based on the methods for preparation of activated silica will be discussed in a separate paper. Essentially, though, a part of plant design is to make useful chemical processes convenient. Many existing plants can adapt their facilities without much effort, but the greatest convenience will be had when the activated silica process is fitted into the plans for a new plant or when provision is made for its later installation.

Two valid criticisms of activated silica have been that it did not assist coagulation in many cases and that it sometimes caused filter plugging. These problems will be the principal concern of this paper. It is believed that the answers to them will point the way to improving plant design and operation both when activated silica is employed and when the older coagulating procedures are used.

Pretreatment Aids Filtration

The shift in emphasis from filtration to coagulation as the major force in water clarification developed naturally and is just reaching full appreciation. Today a number of water plants, both industrial and municipal, produce better quality water without filtration than was previously achieved with filtration aided by a half-successful chemical application.

C. R. Cox[5] has convincingly stressed the importance of chemical treatment in an article entitled "Pretreatment of Water for Effective Filtration." Cox, who is well known as Chief of the Bureau of Water Supply, New York State Department of Health, stated: "Improved pretreatment has improved filter operation by reducing the amount of material removed by the filters and has reduced the amount of wash water required. Furthermore, effective pretreatment permits the use of coarser filter sand or anthrafilt than otherwise would be the case, which in turn prolongs filter runs and facilitates washing. Probably the most important aspect of improved pretreatment so secured is the possibility of operating filters at somewhat higher rates than the conventional 2 gpm. per sq. ft., so many of the recent filtration plants are specifically designed to benefit by this situation. The higher rates are not feasible, however, unless the whole plant is designed for this purpose."

High rate of flow operation requires competent operators in addition to efficient pretreatment. Where well-trained persons are employed, public health officials will probably allow the more economical practices which also improve water quality.

Flash Mixing and Point of Chemical Addition

The inclusion of facilities for the flash mixing of chemicals has become standard design practice, but this provision is made only for the coagulant. If soda ash, lime, and sulfuric acid were recognized specifically as coagulant aids, similar in function to activated silica, more consideration might be given to these floc promoters. The easy and careless way to add chemicals for coagulation is to dump them all in at the same point. This works fairly well in many cases but in others failure has led to a better method. The coagulant and the coagulant aid should be added separately with rapid and complete distribution of each one.

The importance of separate addition of coagulant and coagulant aid was established prior to the use of activated silica but it now attains greater significance. As originally recommended with alum clarification, only one order of silica addition was used. Many water supplies did not respond favorably in this way but they gave excellent results when the order of addition was changed. For low turbidity waters it is preferable to introduce the activated silica into the raw water sufficiently early to permit complete distribution ahead of the alum flash mixer. In other cases, the reverse order of addition is required with sufficient retention and agitation to permit the formation of a pin-point floc before the silica addition. This is especially true in color removal and with high turbidities. While silica is usually added ahead of lime for calcium carbonate precipitation, the addition several minutes after the lime seems best for magnesium removal.

A plant designed for silicate treatment should have two points of chemical application at both of which high turbulence is provided. One can be at the suction side of the low lift pump, or at the aerator, if either of these is convenient to the chemical feeding devices and if the coagulant aid should be added first. Coagulant aids do not produce a floc by themselves; therefore, their detention time is of little significance as compared to the thoroughness of their distribution. Flash mix basins having 20-40 seconds' detention are adequate for the coagulant aids if the requisite high turbulence is provided. A well-designed hydraulic jump may also produce effective flash mixing. When the coagulant aid is added after the coagulant, the detention time in the coagulant mix basin should be longer. A detention of at least one minute, and preferably two or three, is suggested to permit formation of pin point alum floc before delivering the water to the second flash mix. When silica is used, there seems to be no occasion to fear breaking up the floc in the second mixing basin.

In one of the water plants of the Consolidated Water Power and Paper Company, Klinger[2] obtains excellent year-around results through the use of two identical flocculating basins each having four minutes' retention. With this colored water, previously difficult to treat, it is necessary to add alum at the entrance to the first mixer and silica to the overflow between the two. This produces a "snow-storm" floc in the second mixer.

When a variable water supply is to be treated, it is advisable to provide double flash mixing basins with a few minutes' retention in each and to arrange the chemical feed lines so that the order of addition may be

changed according to the character of the raw water. If it has not been determined that the silicate treatments are to be employed, provision should be made that will permit the later installation of the second flash mixer. With this provision the plant design will be sufficiently flexible to accommodate new treatment practices and it will not become obsolete before its time. Other coagulant aids than activated silica will also benefit from these provisions.

Floc Conditioning and Settling

No special consideration need be given to conditioning a silica-alum floc other than recognized modern practices. The old style end-around or over-and-under baffles can be used with success if there is sufficient retention time and velocity. Frequently in this design, the velocity is too low and the advantages of the silicate treatment are completely lost; sometimes an even poorer result may be obtained than that with alum alone. The silica-alum floc is strong and is improved by high velocity conditioning. This is a prime reason why the silica processes are attaining a place of importance in newly constructed water treatment units of both conventional and upflow types. Mechanical agitation is generally preferred for high velocity floc conditioning.

In proper chemical balance, the silica floc, whether produced with alum in clarification treatments or with calcium carbonate and magnesium hydroxide in the case of softening, forms and settles in about one third the time previously required. The greatest advantage of this comes in the winter months when coagulation is most difficult. In most cases 10-20 minutes of conditioning proves ample with velocities about 50-100 per cent greater than customary. Because of the heavier floc produced with silica, it is necessary to maintain a somewhat higher velocity to prevent settling in the mixing basin or flumes.

In one plant of rather unusual design, the sludge contour was accurately determined in a settling basin which had only forty-five minutes' retention time. The water passed through the long, narrow, and deep basin at a rate of two gallons per foot per minute. With alum and pH correction, the floc proved too light, and passed out of the basin and into the filters making it impossible to continue operation at the high rate. The sludge pattern showed very little sedimentation in the first third of the basin, then increased in depth through the next third, but remained fairly constant throughout the final third. After cleaning out this sludge and by coagulating with silica and alum, the exact reversal of this pattern was obtained. This change in chemical treatment permitted the continued use of settling basins which would otherwise have required considerable enlargement. The experience also verifies the feasibility of using shorter settling times in new plants.

The most thorough studies of the effect of activated silica on plant design have been those of Baylis[6,7,8], who concluded[8]: "As a result of the development of means of strengthening the coagulation, there is a saving of over 25 per cent in settling time and filtration area regarded as safe design without such means." The detailed description of the Chicago South District Filtration Project indicates this reliance upon activated silica. Whereas the usual Lake Michigan water plant operates with a mixing time of 40-60 minutes, a settling period of 5-6 hours, and a filter rate of 1.5 gpm. per sq. ft.[8], the Chicago plant expects to be able to produce an unusually high quality water without difficulty at a 600 mgd. rate with 28 minutes' mixing, two hour settling, and filter rates of 4.0 gpm. per sq. ft. for continuous operation up to six hours during the summer months[9]. In winter, when the value of activated silica will be relied upon most, the minimum mixing time will be 37 minutes with 2.9 hours' settling and 3.0 gpm. per sq. ft. filtration.

Referring to the capacity characteristics of the Chicago plant, Baylis[8] stated: "The design is not in full accord with the greatest indicated economy, but it is in that direction. It was thought best to be on the safe side and await operating experience on the large plant. . . . Provisions for the preparation and use of this specially prepared silicate constitute the major deviation from conventional treatments in the design of the plant. . . . The extreme conditions, which heretofore have limited the capacity of filtration plants, are to be provided for largely by special treatments of the water." Now that this plant is in operation, it is hoped that the engineers and chemists in charge will continue their valuable scientific research and determine the maximum capacity with various raw water conditions. The publication of such data will materially affect future water plant design.

Filter Performance with Silica-Alum Floc

It has been previously indicated that filtration rates of from 3.0 to 4.0 gpm. per sq. ft. are now becoming a part of regular municipal practice. A number of cities have accepted rates of 3.0 gpm. per sq. ft. without the assistance of floc toughening coagulant aids[10]. Rates well above 4.0 gpm. per sq. ft. are justified for many industrial plants and, if properly planned, the water quality need not be lower than that now obtained in many cases at half these flow rates.

Baylis[7] clearly proved the advisability of using high rate filtration with coarse filter media. "Filtering material 1.00 mm. effective size is approaching the limit in maximum size of material which may be used when water is treated with acid-treated sodium silicate and aluminum sulfate . . . sand of 1.56 mm. dia. effective size, is too coarse for the silica treated water, though much less coagulated matter passed during periods when the silica was used." In a later article[8], he stated: "Experiments with silicate treated water indicate that sand having an effective size of 1.0 mm. will filter water fully as efficiently as sand of 0.5 mm. without use of silicate. To be well on the safe side, sand between 0.62 mm. and 0.70 mm. effective size is being specified." It may be seen from the foregoing that "torpedo sand" (0.8-1.2 mm.) or corresponding anthrafilt, may become the standard sized media of the future. The advantages of using large filter media are higher rates of flow, longer filter runs, less backwash water (but higher backwash rates), freedom from mud balls and clogged areas, and less loss of filter media. Prior to the studies with activated silica, Baylis[11] correlated length of filter runs with sand size and filtration efficiency.

With activated silica capable of giving the highest quality of water at high filtration rates through coarse media, it is natural to ask what it will give with very fine sand. The answer is trouble! One might say "trouble in any language" since Yakovenko[12] evaluated the silicate methods for the Soviet Army and concluded that it improved coagulation but made filtration more difficult. It was not unusual during the early period of introducing the silicate methods to enjoy the sight of the "immense" floc that went into the settling basin and the sparkling water that came out. Although this water needed no more "polish," it did need straining to remove the

tiniest floc particles. That should have been easy for the filters, but it wasn't. The alum-silica floc was tough and, in these cases, the sand size was small. In contra-distinction to alum floc, there was no penetration of the filter and the surface sealed over. Quick back-washing ended the trouble—and the silicate test.

Filter plugging may be obtained with floc from alum, iron salts, calcium carbonate, and magnesium hydroxide. When silica becomes a part of this floc the troubles sometimes increase; at other times filter runs become two or three times longer. Careful comparisons between operations in the different plants revealed more than could readily be deduced from any one of them. That a number of factors are involved became evident. First there must be a good floc conditioning. Low velocities will not adequately dewater the tougher floc, settling will be poorer, and an unnecessary amount of floc will pass on to the filter. With the lack of penetration, filter runs will shorten.

Ratio of Coagulant to Coagulant Aid

The second factor is ratio of coagulant to coagulant aid. R. E. Noreus, Technical Manager of the Northwest Paper Company, reported lengthened filter runs as their usual experience[3], but later he suddenly encountered plugging which he described as follows[13]: "In February, with a color of 140, alkalinity 47, and temperature of 32, we gradually reduced the alum treatment from about 4.5 grains per gallon to 4.0, the pH gradually rising from about 5.9 to 6.2. This was the lowest treatment we had ever had. During this period we used 11-13 ppm. of silica and were obtaining 90 per cent color removal. Our filters gradually slowed up and we actually ran out of water twice. We tried washing more frequently without benefiting; we increased the silica to 17 ppm. and then cut it off, without results. Finally, we raised the alum to 6.0 grains per gallon with 11 ppm. of silica, decreasing the pH to 5.6 and our troubles disappeared. We ran into this condition again this spring and again eliminated it in a hurry by increasing the alum ½ to 1 grain without changing the silica, which was being applied at 6-8 ppm. This appears to indicate a definite ratio of alum to silica is important. We do not feel the pH has any bearing on the filter plugging that we encountered but it is due only to the alum added.

"We have had no trouble with mud balls, although this same condition applies to the last few years also. Our filter sand has an effective size of .4-.5 and a uniformity coefficient of approximately 1.6. We have certainly had a very successful period of operation in our filter plant during the past year and attribute this success almost entirely to activated silica."

Ratio of Filter Medium Size to Sedimentation Efficiency

Klinger[2] was able to make an excellent contribution to the elimination of filter troubles as a result of having three different plants for experimentation. In his first plant experience with activated silica, an immediate improvement in water quality was noted, but "after a few hours of operation back-wash increased to a point where it was practically impossible to operate. . . . With a sand size of 0.45 to 0.5 mm. it was possible to back-wash at 12 to 15 gallons per sq. ft. fairly efficiently with alum alone, but this rate . . . was not sufficient for the silica alum floc." After replacing the sand with Anthrafilt of 0.7 to 0.75 mm. average size, thereby permitting better washing at the 12-15 gallon rate, and after installing Palmer agitators, he reported: "With the efficient surface wash produced with Palmer agitation, negligible dirt remained after back-washing, and filter plugging was entirely eliminated. It is interesting to note that one of the original sand beds had not yet been replaced with Anthrafilt at this time, and even this bed operated properly because of efficient surface washing due to the auxiliary agitation."

In a second plant provided with 0.35 to 0.40 mm. sand, Klinger experienced even more severe plugging when activated silica was tried. He explained: "The causes of plugging are mechanical and hydraulic imperfections which have to be rectified by mechanical and hydraulic modifications. These are now being made and it can be said with confidence that the trouble should be definitely eliminated." At his third plant, the filter sand is 0.33 to 0.50 mm. and Palmer agitators are installed. When activated silica was used here, Klinger reported, "An extremely dense and heavy floc resulted. . . . There was no filter plugging. . . . Since this plant is not taxed for capacity, flocculation and sedimentation efficiency is somewhat higher."

The third factor in filter performance, then, is the relation between filter medium size and sedimentation efficiency. When activated silica is used to obtain the higher quality water that is possible with it, there is this alternative: either one must have somewhat great sedimentation time if small sand is to be used or one can have smaller sedimentation basins if large-sized filter medium is used. Obviously, the latter is the more economical.

Efficiency of Filter Washing

The fourth consideration in handling the silica-alum floc is the efficiency of filter washing. With a heavier, stronger floc it is natural that higher rates of back-wash or some other means of breaking up the floc, such as surface washing devices, should be required. It will be noted that all of the mechanical requirements for optimum plant efficiency with activated silica are in line with the present trend in design. The use of silica permits a more rapid progress in these engineering developments.

Filter Performance with Lime Softening

When activated silica is used with lime softening, a somewhat different type of filter plugging can be experienced. It is quite different from the calcium carbonate-magnesium hydroxide caking which has been frequently reported with previous softening practices.

Activated silica, prepared by acid neutralization, was used from 1939 to 1941 in a Louisiana softening plant rated at 4.0 mgd. and operating at 2.0 mgd. Turbidities of 600 ppm. were frequent and of 3,000 to 5,000 occasional, but clarification with lime, ferrous sulfate, and silica was excellent. Objections to the use of sulfuric acid, coupled with filter plugging which probably resulted from failure to properly neutralize the silicate, caused the use of silica to be abandoned. The development of ammonium sulfate as a replacement for sulfuric acid produced a new interest in 1943. Better settling was desired as the water demand had then reached 4.9 mgd. The return to activated silica cut the turbidity applied to the filter from 15-20 ppm. down to 5-7 ppm., and lengthened filter runs. It was noted, however, that there was an increase in the drop of alkalinity through the filters which would seem to indicate a greater rate of sand growth. The operators decided to switch to acid neutralization and promptly encountered filter plugging, whereupon the use of activated silica was again stopped.

In the foregoing example, two precautions for the use of the silicate processes in softening are indicated. In the first place, the preparation of the activated silica must be controlled, using a formula that neutralizes most of the sodium alkalinity of the silicate. In the second, it is not possible to utilize the silicate method at rates higher than nominal capacity unless adequate mechanical agitation is provided for breaking the supersaturation. No mechanical mixing was available in the Louisiana plant; it is not recommended that silicate coagulant aids be tried again until such equipment is provided or the retention time in the baffled conditioning basin is increased.

Black[4] reported on the very successful use of activated silica in Florida, where it has replaced alum in a number of softening plants. He stated that filter runs were greatly lengthened, a softer water was produced and appreciable chemical cost savings were obtained. He pointed out, however, that in Florida also it was noted that at some plants there was a tendency for greater calcium carbonate supersaturation. Black explained: "This is not surprising since the rapid formation of the very large 'leathery' floc particles, some of which begin to settle in the mixing basins at the mixing velocities used, greatly reduces the total exposed area of calcium carbonate particles which in a poorly settled water tend to 'seed' the solution and grow at the expense of the dissolved calcium carbonate. Higher mixing and conditioning velocities are indicated in such cases. . . ."

The writer has followed the record of a Florida softening plant which has used the N-Sol A process for three years and has been advised that the sand is in much better condition than it was prior to this treatment. In no instance has sand growth been observed in Florida as a result of silicate processes. Both the acid and the ammonium sulfate methods of preparing activated silica are used in Florida. Several of those using the acid method observed a cementing of the sand and abandoned the silicate process. No such trouble has been reported with N-Sol A. Upon checking at one plant, a military camp, which had gotten into this trouble with acid treated silicate, it was determined that unwittingly the supply depot had provided a different grade of sodium silicate from that previously used, but this was not noticed by the operator. It had a higher alkali content which should have been taken into account. As soon as the formula was corrected the trouble ended.

The Baylis method calls for neutralization of 85 per cent of the alkalinity of the sodium silicate. In the Florida case just mentioned, only 80 per cent had been neutralized, and plugging occurred. This may indicate that the Baylis formula, developed primarily for use with alum clarification, is too near the border line for good filter results wherever softening is involved. A modified formula carrying neutralization to 95 per cent was recommended by the writer. It is being used successfully without a recurrence of filter trouble.

The N-Sol A, N-Sol C (chlorine reaction), N-Sol D (sodium bicarbonate), and other N-Sol processes which permit 100 per cent reaction can be used with greater assurance of favorable filter experience and operating economy. To date there is only one exception to the opinion that neutralization should approach 100 per cent. One plant in Pennsylvania adds sodium silicate to lime-softened water without neutralization. No deleterious effects on the filters have been observed, although this same practice has produced troubles elsewhere.

Economies in High Rate Operation

The present upward trend in prices for materials and services will make it more desirable to operate at high flow-rates. Savings made possible by such operation are readily apparent to consultants and equipment manufacturers. They are sometimes overlooked by water plant superintendents who may have an undeniable concern about daily labor and chemical costs.

In purposely general terms, Sheen[14] has indicated that the flocculation and filtration sections of an industrial water plant may constitute a capital investment of $20,000 to $60,000 per mgd. The annual capital charges (depreciation, interest on investment and maintenance) usually figure 20 per cent. Based upon the mean value of $40,000 per mgd., this represents a daily fixed charge, exclusive of labor, of $22 per mgd. assuming operation at full capacity. If this plant could produce the same quality of water at 125 per cent of rated capacity through a different chemical treatment, there would be a credit of about $5.50 per million gallons which could be applied against any increase of chemical cost. In municipal practice, where capital investment is greater by 25 to 50 per cent, there would be a correspondingly greater fixed-charge credit.

It is not implied that chemical methods which boost plant capacity generally increase chemical costs. Lower chemical costs, improved water quality, and flows greater than rating are often observed simultaneously. This occurs most often with waters in the "difficult-to-floc" class that respond very favorably to activated silica. There is a larger classification of "easy-to-floc" waters in which activated silica produces better floc formation and settling. Here, however, the chemical treatment cost with it may be as much as a dollar per million gallons higher than with the use of other coagulant aids. Such a costlier treatment may not be justified while the plant is operating below capacity. If water demand later approaches capacity, and expansion is considered, first thought should be given to increasing capacity through the more favorable chemical treatment.

In keeping with the foregoing possibility, provision should be made in nearly all new plants for immediate or later adoption of a silicate process. Then an unexpected demand or the development of an unusually difficult period of coagulation need not be serious. Another tool for meeting such emergencies with convenience will have been provided. A number of water plants have installed the silicate processes for periodic use only. Some did this for winter benefits, but they subsequently found the values throughout the year to be such that the feed was continuous. Advantages not readily demonstrated in jar tests, such as better filter performance or higher water quality, were responsible.

The proper chemical and mechanical pretreatment of the water will have a very great effect upon initial construction costs, the economy of operation, and the quality of water produced. The selection of the best chemical treatment can with full reliance be based upon jar tests capably run. These, however, are not as simple to conduct as is usually thought. It should be true in the future, though it certainly is not today, that the best results obtainable in jar tests should also be obtainable in plant practice. Equipment can be installed which makes this possible. Cox[5] stated it as follows: "Any great superiority (in jar tests) over the results secured with an existing full-scale unit indicates an inherent inadequacy. The problem then is to determine whether the deficiency of the large basin is one of degree of agitation or period of agitation."

Conclusions

It is not those who have adequately studied the use of activated silica in modern water treating equipment who are skeptical of its values for improving coagulation. In several water treatment plants which have admitted deficiencies, its use has permitted successful operation. Best results with activated silica are obtained in the more numerous instances where it is used with equipment which is in full accord with the present design trend.

In the design and operation of conventional floc conditioning and sedimentation plants, one should consider the probability of producing higher quality water at rates 25 per cent or more above current practice. Such an increase in flow rates may reduce expenditures for equipment and maintenance by an amount exceeding the total chemical cost of coagulation for many waters.

To obtain most efficient results with activated silica in plants of conventional design, it is recommended that the following provisions be made: (1) Two points of chemical application each with flash mixing. (2) Higher velocity conditioning for a shorter period of time. (3) Reduced detention time for sedimentation. (4) Filtration designed for, if not immediately operated at, 4.0 gpm. per sq. ft. for municipal plants, and 6.0 gpm. per sq. ft. or greater for some industrial plants. (5) Coarser filter media to obtain high rates and long filter runs. (6) Increased backwash rates and greater use of surface washing devices.

Activated silica has provided the correct chemical balance in water for clarification, softening and color removal in high rate upflow units, thereby further increasing the operation rates and efficiency. Several examples of upflow operation with silica will be discussed in Part II, which will appear in a forthcoming issue of *Water and Sewage Works.*

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Pension and Retirement Plan of Des Moines Water Works

On page 269 of our July issue, as a part of the report covering the Am. Water Works Assn. convention in St. Louis, was reported the remarks of Mr. Dale Maffitt concerning the Pension and Retirement and Group Insurance Plans of the Des Moines (Iowa) Water Works. We regret to say there were several errors in this portion of the report which we wish to print a correction of even at this late date.

First, Mr. Maffitt points out that the Pension and Retirement Plan is entirely separate from the Employee's Group Insurance Plan of the Des Moines Water Works. Second, in the Retirement Plan, 3 per cent of the employee's earnings are deducted as his contribution, and the Water Works contributes whatever may be required to meet the complete cost of maintaining the Retirement System in a solvent condition, including that amount necessary to amortize the remaining unfunded past service requirement over the remainder of the 25 year period following the date on which the Retirement Plan was placed in effect. In the early years of the Plan this of necessity represents more than 3 per cent of the employee's salary which is deducted for deposit to his credit in the Plan.

An employee who retired on or after becoming 65 years old becomes entitled to an annual annuity equal to the sum of the following:

(1) One and one-half per cent (1.5%) of his earnings during each year of service *after* the date on which the Plan became effective.

(2) In addition, one per cent (1%) of earnings during each year of service *prior to* the effective date of the Plan, but not exceeding 26 years.

The Des Moines Water Works has had printed booklets describing its Employee's Group Insurance Plan, and "The Des Moines Water Works Retirement System" is described in a mimeographed brochure which covers all details and contingencies in the form of a "Declaration of Trust." Anyone interested would do well to request a copy of each from Dale L. Maffitt, Gen. Mgr., Des Moines Water Works, Des Moines, Iowa.

Kansas City's Report a Model

In speaking before the AWWA Meeting in St. Louis, Melvin P. Hatcher, Director of the Kansas City (Mo.) Water Department, said that annual reports should be written so they can be understood by the lay public as well as technical personnel. The most recent annual report of Kansas City's Water Dept. exemplifies what Mr. Hatcher means, for he has practiced what he has preached.

Amply illustrated with understandable pictures, photographs, and graphs, this report can well serve as a model for water (or sewage) utilities faced with the preparation of annual reports. Beginning with an organization chart that actually shows personnel, divisions, and costs of departments, the report briefly, but clearly, discusses the various divisions, such as engineering, pumping, purification, collections.

Each section of the book has an introductory sketch indicating the subject matter. Each section, too, has its own charts or tables that tell the story. For example, a quick run through of the report shows that (1) the Kansas City Water Department sells water to 17 districts outside the City, (2) the supply has been softened since 1942, with the hardness of the finished water varying from 90 to 130 ppm., (3) total revenue for the year 1944 exceeded expenses by nearly $300,000, and (4) the bonded indebtedness will be practically retired in 1962. The book is concluded with balance sheets, and rates for service. No doubt Mr. Hatcher will be glad to send a copy of his Kansas City report to any who may request it.

THE WATER SUPPLY OF EGLIN FIELD, FLA.

Constitutes a Study in Corrosivity and Non-Corrosiveness of Natural Waters

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Ass't Sup't
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RALEIGH, N. C.

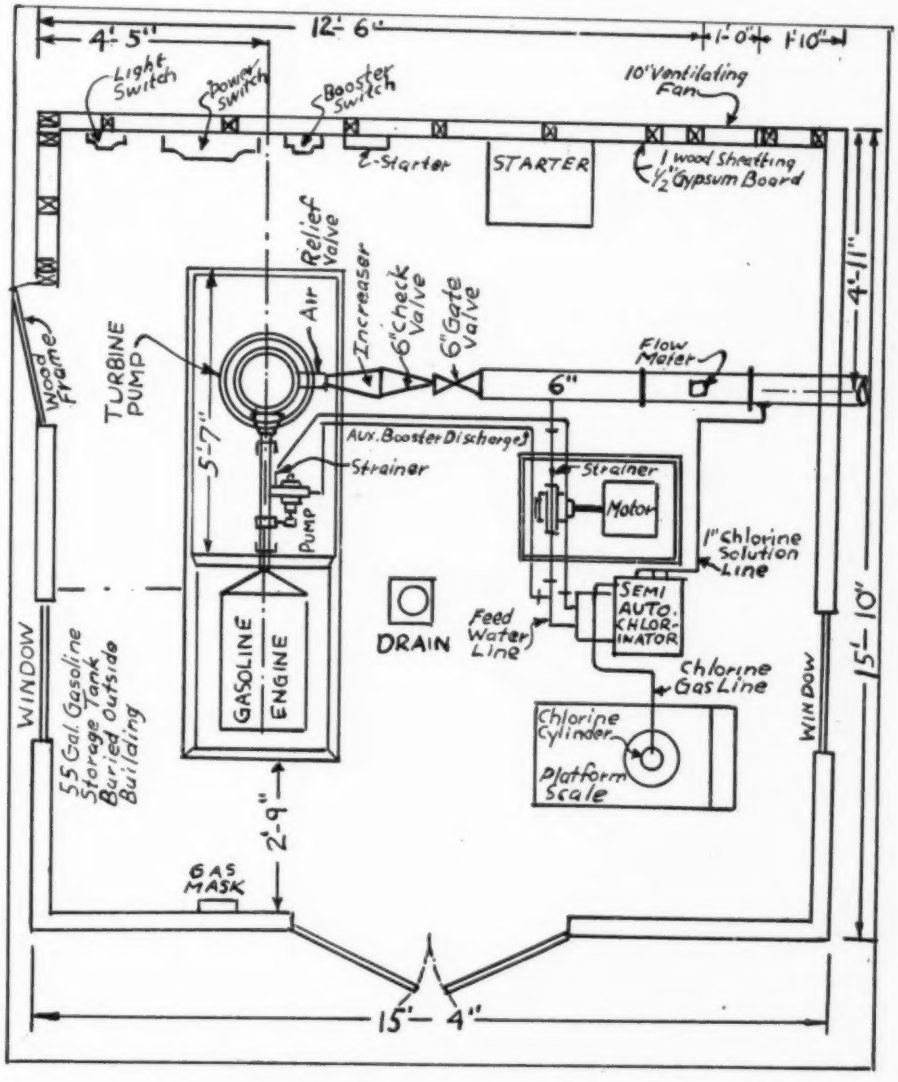
The Author

EGLIN FIELD is the Air Forces proving ground where aerial warfare equipment and material are tested to determine their value for combat use. This is the primary objective of Eglin Field, which includes parts of Santa Rosa, Okaloosa and Walton Counties in Northwestern Florida, and which is approximately 50 miles east of Pensacola, Fla. Most of the several hundred square miles comprising Eglin Field is unsuitable for cultivation. Several of the ten auxiliary fields surrounding the main field are devoted to gunnery training for combat pilots. Eglin Field has been designated a permanent installation. Its work is vital to the success of our Air Force. It is the foundation for victories achieved and lives saved because it furnishes our Air Force with the "Know How."

Nature of Water Supply

All water at Eglin Field is obtained from wells 600 to 650 feet deep, equipped with deep well turbine pumps. All pumps can be operated by a standby gasoline engine in case of electric power failure. A typical pump station is shown in the accompanying sketch. These are compact, efficient pump stations. Pump capacities at Fields 1 through 7 vary from 240 to 275 gallons per minute, pumping against total heads varying from 170 to 360 feet. Pump sizes are 8 inch and the number of stages varies from 7 to 14. Field No. 9 pumps have a capacity of 135 gallons per minute against a total head of 245 feet. Pumps on the main field have a capacity of 900 gallons per minute against a total head of 151 feet. Main Field pumps are of 12 inch size and have 3 stages.

Pressures maintained at all parts of distribution systems vary from 50 to 55 lbs. per square inch. The Main Field will consume from 450,000 gallons per day during winter months to 650,000 gallons per day during summer months, to give a per capita consumption varying from 56 gallons to 82 gallons. Considerable water is necessarily used in watering lawns during the hot summer months. Consumption at the auxiliary fields varies from 15,000 to 20,000 gallons per day, some of the fields having more men than others, but the per capita consumption averages about the same as the Main Field. Each auxiliary field has two pump stations, which pump into an elevated steel storage tank holding 75,000 gallons. (The Field 9 elevated storage tank is of wood and holds 10,000 gallons.) On these steel storage tanks is installed the "Rustop" system of



Typical Water Pumping Station—Eglin Field, Fla.
(Of which there are twenty in all.)

*Formerly Asst. Post-Engineer, U. S. Engineers, Eglin Field, Fla.

TABLE 1

CHEMICAL ANALYSES IN PARTS PER MILLION

	Eglin-Main Field					Field 1		Field 2		Field 3		Field 4		Field 5		Field 6		Field 7		Field 9	
	Well 3	Well 4	Well 2	Well 4	Dist. Syst.	Well 1	Well 2	Well 1	Well 2	Well 1	Well 2	Well 1	Well 2	Well 1	Well 2	Well 1	Well 2	Well 1	Well 2	Well 1	Well 2
pH (Lab.)	7.8	7.7	7.4	7.5	7.3	7.4	7.4	7.4	7.5	8.0	6.8	7.4	7.6	7.5	7.5	7.5	7.4	6.0—	6.0—	8.4+	6.0—
pH (Field)	..	..	7.5	7.5	7.4	7.6	7.6	7.5	7.6	7.9	7.5	7.4	7.6	7.5	7.5	7.5	7.5	5.5	5.1	8.0	5.0
Color	7	39	5	3	3	7	12	12	19	8	10	19	25	12	10	12	12	8	12	12	65
Turbidity	0	3	3	4	3	3	..	2	..	5	8	5	4	3	..	3	..	2	3	3	10
CO_2 (Lab.)	1	4	5	1	1	2	2	4	3	1	1	5	3	3	3	4	6	4	7	1	27
CO_2 (Field)	..	..	0	14	4	2	2	8	0	2	2	1	0	0	0	..	..	5	14	0	51
Total solids	179	148	157	161	172	155	154	147	142	138	157	164	168	157	157	265	276	22	25	351	43
Alkalinity as $CaCO_3$:																					
OH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO_3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HCO_3	127	121	132	131	126	123	121	119	116	122	135	134	138	130	127	182	182	6	3	190	11
Total	127	121	132	131	126	123	121	119	116	122	135	134	138	130	127	182	182	6	3	190	11
Magnesium as Mg.	11	11	0	0	5.8	11.6	10.6	7	4.4	10	8	4	11.6	9.7	8.7	6.3	2.4	1.9	0	1	4.8
Calcium as Ca.	25	26	41.6	51.2	41.6	26.4	28.8	39	44	38	43	40	38.4	28.8	28.8	16	16	0.8	0.6	3.2	0.8
Iron as Fe.	0	0.55	0	0	0	0	0.1	0	0.25	0	0	0	0.25	0.1	0.1	0.25	0.5	0	0	0.1	2.0
Manganese as Mn.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorides as Cl.	3	5	6	6	7	5	5	4	5	4	3	6	5	5	5	38	38	6	5	76	9
Sulfates as SO_4	8	12	4	4	3	4	4	2	7	2	4	4	4	4	5	4	3	2	2	2	2
Silicates as SiO_2	15	18	12	12	12	13.5	12	12	9	9	9	12	12	12	12	24	21	6	1.5	12	9
Nitrites as NO_2	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.003	0	.016	0	0	0
Nitrates as NO_3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total hardness as $CaCO_3$	107	109	104	128	128	114	116	126	128	138	140	116	144	112	108	66	50	10	1.5	12	22
Non-carbonate hardness as $CaCO_3$	0	0	0	0	2	0	0	7	12	16	5	0	6	0	0	0	0	4	0	0	13
Sodium and potassium as NaCl.	4	6	9	9	11	8	8	1	2	13	3	9	6	8	8	63	63	7	8	125	0
Fluorides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0	1.0	0
Field diss. oxygen	..	..	2.35	.128	.468	.064	.12	.168	.04	.072	.12	.268	.032	.088	.11	.068	.14	9.46	9.64	.796	0
Field temperature, °F.	..	..	78	78	77	75	75	78	76	78	78	78	74	72	75	76	78	76	76	80	74
Lbs. Cl_2 per Mg. to give 0.4 ppm. res.	31.0	28.7	..	..	..	18.7	18.9	29.3	22.8	17.3	17.8	16.0	17.5	15.5	18.8	23.9	29.9	15.1	14.1	91.5	119.0
Corrosion index	—4	0.3	—3	9	5	0	1.2	8	7.4	7	3	—1	5	—2	—2	—15	—16	94	219	—20	415

Analyses by Fort McPherson, 4th Serv. Command, Atlanta, Ga.

Corrosion Index figured using formula No. 1 taken from Water Works & Sewerage Reference & Data Edition, June, 1944, Page R-137.

$$\text{Corrosion Index} = [CO_2 + \tfrac{1}{2}(\text{Hard.-Alk.}) + Cl_2 + 2N]\ \frac{75}{\text{Alk.}}$$

0- 5—Extremely non-corrosive.
6- 25—Non-corrosive.
26- 50—Moderately corrosive.
51- 75—Corrosive.
76-100—Very corrosive.
101+ —Extremely corrosive.

cathodic rust prevention. This system, in which a small direct current of 1 ampere, 20 volts, is kept flowing from the center anode toward the walls of the tank has proved very successful in preventing the rusting of the tanks.

On the Main Field there are four pump stations and two elevated steel storage tanks of 100,000 gallons each. The top of one of these tanks is about 22 feet below the top of the other tank, they originally having been parts of different systems. This makes necessary the use of an altitude control valve on the lower tank.

The distribution system on the Main Field has only one dead end. This system consists of the following cast iron pipe: 38,725 ft. of 6 in., 7,162 ft. of 8 in., 4,160 ft. of 10 in., and 7,441 ft. of 12 in., making a total of 57,488 ft. or 10.9 miles.

Each auxiliary field distribution system consists of the following cast iron pipe: 3,194 ft. of 6 in. and 1,442 ft. of 8 in., making a total of 4,636 ft. or 0.87 mile.

Chlorination the Only Treatment

Chlorination is the only treatment given Eglin Field water. A residual of 0.4 ppm. is maintained to the farthest parts of the distribution systems. The pounds of chlorine necessary to be fed into the various Eglin waters in order to obtain this residual are shown in table No. 1. The effectiveness of this chlorine treatment is indicated in table No. 2, which shows the results of bacterial tests on Eglin Field chlorinated waters over a period of six months. This is a typical six months' breakdown on bacterial analyses.

TABLE 2
BACTERIOLOGICAL RESULTS
Water Samples—January-July, 1945

Location	Potable Samples	Non-Potable Samples	Per Cent Non-Potable
Main Field	206	3	1.4
Field No. 1.....	86	1	1.1
Field No. 2.....	87	2	2.3
Field No. 3.....	95	1	1.0
Field No. 4.....	86	1	2.3
Field No. 5.....	97	1	1.0
Field No. 6.....	101	1	1.0
Field No. 7.....	103	0	0
Field No. 9.....	92	3	3.2
Range No. 64....	47	0	0

Corrosivity of Waters

In table No. 1 are also shown analyses of waters from all wells supplying water to all the fields which make up Eglin Field. As noted in this table, the most corrosive water is that from well No. 2 at Field No. 9. Consequently, this well is used only in emergencies. Nipples taken from hot and cold lines at Field 9 show no damage whatever from corrosion after 25 months' service. There is a light deposit of scale, uniformly distributed, with no appreciable loss of pipe capacity.

The water from both wells at Field 7 is corrosive, with that from well No. 2 worse than that from well No. 1. Nipples taken from hot and cold lines at this field show very bad corrosion after three years' service. Hot water lines have lost much of their carrying capacity, as much as half in places, with very bad pitting taking place. The cold water lines are pitting, but corrosion has not yet caused appreciable reduction in carrying capacity. Field 7 has the most corrosive water of any of the fields, except for the rarely used well No. 2 at Field 9. This checks with what one would expect after studying the chemical makeup of the waters as reported in Table 1.

Nipples from hot and cold lines at Fields 5 and 6 show no damage at all to pipe from corrosion after three years' service, but instead have a light coating of scale in the cold water lines and a slightly heavier coating in the hot water lines, both uniformly distributed. Cold water at these fields shows only slight corrosion on the bare metal at threads (no galvanizing) while the hot water shows more at these places, but represents very little corrosion for hot water.

Exactly the same things can be said for nipples taken from hot and cold water lines on the Main Field after four years of service.

A Study of Corrosivity

The most significant thing to me about the majority of these Eglin Field natural waters is their stability and non-corrosiveness as compared with the waters that are treated by man in an attempt to get a water of the same non-corrosive quality. What corrosive quality these natural waters have is kept from being effective by the scale of just the right thickness and uniformity deposited by them in the pipelines. Note the low pH values of the natural waters (Table 1) as compared with the artificially treated ones we produce in most of our water treatment plants.

The corrosion index shown in Table 1 was calculated by using a suggested formula in an article by T. M. Riddick in *Water Works and Sewerage's* Reference and Data Edition of June, 1944, page R-137. He recommended a formula for waters on the eastern seaboard. Results listed in Table 1 show a fine correlation between evaluations when employing the formula and the observed action of the well waters on pipes.

Despite the fact that Eglin Field is a permanent installation, no additional treatment is indicated for these waters except at Field 7 and for well No. 2 at Field 9, if ever necessary to use it to any great extent; and possible local CO_2 removal just ahead of water cooled refrigeration and air conditioning units having copper or steel coils. The copper tubing in the condenser taken from a mess hall refrigeration unit on the Main Field showed very bad pitting and copper carbonate deposits after one year of service—see picture of pipe specimens. Water flowed through the copper tubing and the gases around it.

Pipe Specimens from Eglin Field.
(Refer to Table 1 revealing chemical analyses of the various waters involved.)

Left—Hot water line after 3 yrs. in service at Field No. 5.
2nd Left—Refrigeration condenser tube of copper after 1 year service in Mess Hall of Main Field. Water flows through tube and refrigerant gas around it.
3rd Left—Hot water line after 3 yrs. service at Field No. 7. Compare this corrosion with protective film deposited on pipe walls in Field 5, and the analyses of both supplies.
4th Left—Cold water line after 3 years' service Main Field. Note protective film deposited on pipe and refer to chemical analysis in Table 1.

Water heaters in mess halls and the hospital have copper coils carrying steam, which are surrounded by water. Steam flowing in the coils comes from boilers being treated with soda ash, sodium metaphosphate and tannin. These coils have not caused any trouble from corrosion in four years, but must be cleaned of scale deposits about once every three months.

Steel coils in the cold storage plant condensers and copper coils in the Commissary refrigeration condensers corrode very little but scale deposit has to be removed every three months. Water flows on the outside of the coils and these plants have now been in use for four years without any coil replacements.

In these days of Army criticism, I am glad to be able to state that the Repairs and Utilities Division of the Fourth Service Command deserves high praise and credit for the wonderful job it did in preventing sickness in our camps, and for the comforts and convenience it provided our soldiers in its work to assure safe and ample water and sewage facilities.

THE BASIC CAUSE OF INFLATION

By Halbert P. Gillette
President
Gillette Publishing Co.

In a recent article in the *Saturday Evening Post*, Frank Albert Fetter, Professor Emeritus of Political Science at Princeton University, said: "The real cause of inflation is well known alike to students of theory and to practical financiers. Without the shadow of a doubt, that cause is the enormous increase in money and of bank demand deposits. . . . Money of all kinds in circulation was less than $6,000,000,000 in 1933, and by 1945 had increased to $26,000,000,000. Banked deposits subject to check on demand were $15,000,000,000 in 1933 and $106,000,000,000 in June, 1945. Nothing comparable has ever occurred before in our financial history."

In an article published a year ago I pointed out that per capita money outside the Treasury increased about 60 per cent during World War I, yet wages increased nearly 75 per cent, whereas the corresponding increase in per capita money during World War II was 174 per cent. It was also pointed out that while factory and construction wages had doubled during the last war, they probably would eventually rise much more in the course of the next few years. The basis for that forecast was the fact that between 1849 and 1929 average factory wages had kept pace with per capita money outside the Treasury and had risen 350 per cent. Since 1929 that per capita money has risen another 325 per cent.

In the second chapter of my Handbook of Construction Cost (1922) it was pointed out that for more than a century average wages in America had lagged but little behind each increase in per capita money. This law continued to hold until 1933, when President Roosevelt cut the weight of the gold dollar 40 per cent, an unprecedented act that so badly frightened investors that the depression was prolonged. Our entrance into the war was followed by a federal attempt to control wages which was partly successful, especially as to "white collar employees." Hence there has been a repression of wages such as to prevent the full effect of the increase in money. For this reason I look to see average wages become about four times what they were in 1929. Between 1849 and 1929 average wages, following per capita money, became 4.5 times those of 1949. Had it been forecast in 1849 that the then annual factory wage of about $250 would become about $1200 within 80 years, few would have believed it possible. Yet 2000 years ago a Roman writer had called attention to the fact that when Roman legions returned with much captured silver, wages and prices soon became higher. But few people as yet know these two basic economic laws: (1) The trend of average wages is that of per capita money. (2) The trend of average commodity prices is that of wages divided by the productivity of the average worker.

Productivity per American worker has doubled about every 50 years, resulting in average prices half what they would have been had no increase in productivity occurred. Increase in American productivity has been mainly due to the originality of scientists, inventors, engineers and executives. No great and prolonged increase in human productivity occurred anywhere until James Watt invented the condensing steam engine in 1765. That was as epochal a date in applied science as was 1609 in pure science when Galileo reinvented the telescope.

"We hear much talk of the wage-price spiral, as if increasing wages and prices were the mutual causes of each other," says Prof. Fetter, "but the real cause is outside the spiral; it is the excessive supply of money." We hear much also about a prospective great decrease in commodity prices when full productivity of our factories returns, but that, too, is an illusion. Increase in productivity per factory worker is a relatively slow process, usually resulting from better machinery and increased use of power. Farm productivity per worker likewise increases only at a slow pace—much slower than that in factories and mines.

Prof. Fetter suggests restoring the weight of the gold dollar to its pre-1933 value as one way of reducing wage and price inflation. But the immediate effect of such an act might be as disastrous as it was when its converse was invoked in 1933. He suggests retiring bonds as a device for reducing Federal Reserve Notes in circulation, but to be very effective that would involve raising income taxes that are already too burdensome. He says: "Unless Washington does something effective to stop inflation, the nation is headed for the greatest financial explosion in its history." However, "financial explosions" have not been the direct result of inflation of money, but of excessive speculation consequent upon a long period of rising prices and profits, such as between 1919 and 1929. The slight depression of 1920 is often erroneously cited as an example of great ill effects of inflation, but the really great "bust" after a "boom" did not begin till the close of 1929. That great "bust" was mainly due to excessive borrowing for speculative purposes and for unwarranted expansion of plants. And a weak banking system plus President Roosevelt's "clipping" of the gold dollar greatly extended the duration of the disaster.

Mapping the Field of Contamination Over an Ocean Sewer Outfall

By
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PRIMARY effluent from the Joint Sewage Treatment Plant of the Los Angeles County Sanitation Districts is discharged at sea 5,000 feet offshore from White Point in 114-foot depth of water. White Point is a small cape extending seaward from the rocky south shore of the Palos Verdes Hills. The Outfall is so situated that the point of land on shore nearest the end of the Outfall is at least 5,000 feet distant. The Palos Verdes Hills form the north shore of the San Pedro Channel, the south boundary of which is Catalina Island 25 miles seaward.

Before the White Point site was selected for the disposal of primary effluent from the Districts' sewerage works, it was extensively investigated with particular reference to the direction and intensity of prevailing ocean currents, and the final selection was made only after it had been determined that the predominant ocean currents were parallel to the shore and followed its conformation with reasonable accuracy. Notwithstanding the generally favorable dispersal ocean currents, shore waters are investigated for contamination by sewage each week at eight different locations, and occasionally surveys are made of the field of contamination from the point at which the rising column of sewage from the Outfall breaks the surface of the ocean to wherever the field may lead. It is the latter survey that is described in this narrative.

Sewage effluent discharged into salt water rises promptly to the salt water surface, mingling with salt water as it rises. It then spreads over the surface of the sea in a field whose thickness approximates one-twelfth of the length of the path from the end of the outlet pipe to the surface of the ocean. If the sewage is discharged horizontally from the end of the outlet pipe, the path reaching to the ocean surface takes the form of a cubical parabola and its length is greater than would be the case if it were discharged vertically from the end of the Outfall pipe. This additional length of path increases the amount of salt water mixed with each unit of sewage effluent by the time the mixed liquor has reached the surface of the ocean. In the absence of currents the sewage mixed with sea water will spread to form a circular field. If currents are present they carry the field along, the actual motion being the resultant of the radial spreading of the sewage field on the sea surface and the lateral movement due to the ocean current. Under the latter circumstances the field takes on the shape of a sector.

"Official Photographer"
"A.M.R.," The Senior Author, Balanced Atop the Cabin of the Survey Boat.

Outfall Design and Predetermined Dilution

The White Point Outfall was designed using the factors published in a document entitled "Predetermining the Extent of Sewage Field in Sea Water,"[1] written by the authors of this narrative. Design factors indicate that over the outlet of the ocean pipe, where the rising column of mixed sewage and sea water breaks the surface of the ocean, the dilution should approximate 90 parts of sea water to one part of sewage for a flow of 55 m.g.d., and if the analyses of samples taken from this location are averaged, the results indicate close agreement with design. Individual samples show considerable disparity because the column in rising does not mix uniformly with sea water but rolls and billows much as smoke ascending in the air; therefore, as the rising column breaks the ocean surface, there is not uniformity of dilution, but rather a zone of turbulence. As the mixed liquids leave this zone and flow laterally, there develops a greater uniformity of mixture. Factors in the document

Floats for Determining Direction and Velocities of Currents

Zone of Turbulence Over Ocean Outfall Outlet—Looking Landward

Chief Chemist Pomeroy Sampling—A Calm Sea

cited,[1] designed to predetermine the extent of pollution, indicated that at a distance of 350 to 400 feet from the center of the zone of turbulence the dilution of sewage with sea water should be in the ratio of about 225 parts of sea water to one part of sewage. This has now been found to be substantially the case. Although there is some variation, it is not wide, and in general the dilution is about as stated.

While not particularly pertinent to this narrative, it may be of interest to know something of the general currents which flow along the shore of California and particularly along the south shore of the Palos Verdes Hills at White Point.

White Point is about eighty miles northeasterly of a line joining the outer points of the North American continent south of Cape Mendocino. The California current, flowing southerly, follows a general course joining these outer points and sets up swirls or eddies between it and the coast. These swirls persist several days at a time and usually result in a southerly current along the southerly California coast. Under certain wind and temperature conditions the current sometimes flows in the opposite direction.

The Palos Verdes Hills (where White Point is located) form a wide headland about ten miles along the ocean, where there is no opportunity for minor swirls which occur in inlets, with the result that the predominating current is either an easterly or westerly one along the coast, sometimes persisting for several days with only slight modifications due to rotating tidal currents. Generally, the coastal current predominates and the tidal current is able to produce only a small component toward shore or away from it. The water is seldom still.

When the coastal and rotating tides neutralize each other for short intervals, the field takes a nearly circular shape with the dilution increasing gradually toward the periphery and there is no sharp line of demarcation to indicate the field. When there is a strong current along shore, the line of demarcation is pronounced near the outlet of the sewer but fades gradually at the outer boundary of the sector shaped field. In such instances the field is easily seen from shore. Experience has indicated that the field of contamination extends further along the current than the visible field, which, of course is the reason for making a detailed survey.

One Reason for Trying for a Calm Sea
Analysts at Work Making the Ammonia Test.

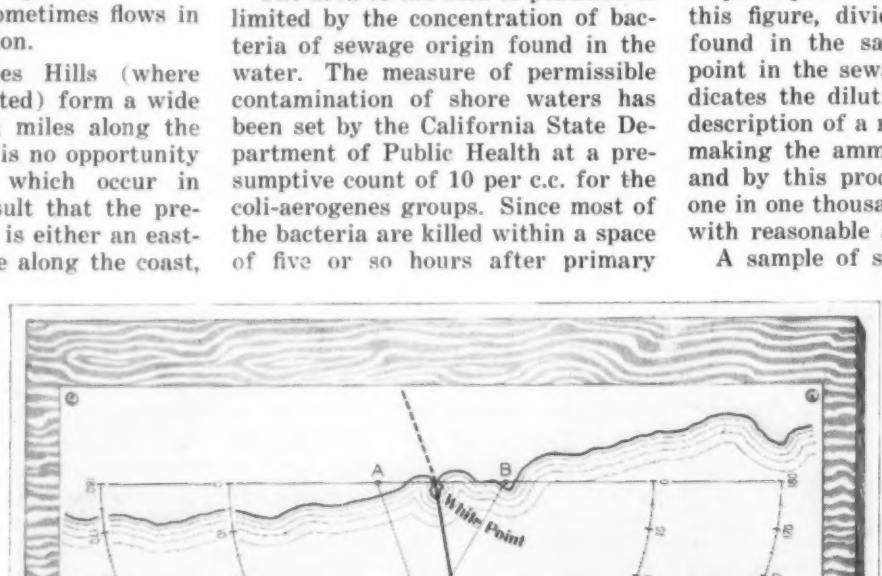
Bacterial Death Rate in Sea Water

The area of the field of pollution is limited by the concentration of bacteria of sewage origin found in the water. The measure of permissible contamination of shore waters has been set by the California State Department of Public Health at a presumptive count of 10 per c.c. for the coli-aerogenes groups. Since most of the bacteria are killed within a space of five or so hours after primary sewage effluent is emptied into the sea, the degree of pollution becomes a function of the time the bacteria have been subjected to the salt bath, as well as the degree of dilution of sewage with sea water. Direct dilution of sewage with salt water cannot possibly account for the great reduction in the bacterial population within a time interval of approximately five hours. The toxic effects of the sea water, or oxidation processes, or organisms in the sea, must account for disappearance of the greater number by far.

STUDYING THE SPREAD OF THE SEWAGE FIELD

Study of the spread of the sewage field, with reference to the time to reach a certain distance from the zone of turbulence over the sewer outlet, is made by taking samples and determining the degree of dilution at various locations in the field until certain dilutions are reached, or certain time limits have elapsed, or both. Dilution may be most exactly measured by determining the ammonia content of the sample. Sewage effluent contains approximately 40 parts per million of ammonia, and this figure, divided by the amount found in the sample taken at any point in the sewage field, closely indicates the dilution. Following is a description of a method[2] employed in making the ammonia determination, and by this process dilutions up to one in one thousand can be measured with reasonable accuracy.

A sample of sea water free from pollution and a sample of representative sewage are taken together on the boat and mixed in proportions to give percentages of sewage comparable to those expected in the sewage field. These mixtures are then treated by the Nessler procedure, which responds to the concentration of ammonia in the mixture. The procedure followed is one developed by Robinson and Wurth. It is the same as the procedure for determining the concentration of so-called "free" am-



The Important Location Chart
Depicting Method of Use on the Survey Ship Receiving Signals from Shore Stations "A" and "B," and Fixing Sampling Points, Float Locations, etc., on Recording Maps.

"The Spray"
Chartered Survey Boat.

monia in water supplies by the Nessler method, except that higher concentrations of tartrates and of sodium hydroxide are required to prevent the precipitation of calcium and magnesium compounds. By comparing the samples picked up in the sewage field with the mixtures of sea water and of sewage prepared at the time, serving as standards, the percentage of sewage in the sample is determined directly.

Determining the Extent of Contamination

To measure the extent of contamination in a sample, the following procedure governs:

Incubation tubes of lactose broth are taken on the survey and immediately after sampling suitable dilutions are planted into these lactose broth tubes. They are then taken back to the laboratory and incubated and those tubes which produce gas within forty-eight hours are replanted into brilliant green bile broths. If gas forms within forty-eight hours in the brilliant green bile broth, then the test is considered positive in that instance without further confirmation. A series of identifications of species producing gas were made and it has been concluded that this procedure of testing is ninety-five per cent correct for coli-aerogenes group. On the basis of the findings in this procedure, most probable numbers of bacteria of the coli-aerogenes group are calculated.

Survey of the Field

Survey of the field of contamination is necessarily conducted from a boat which has its course plotted and charted from fixed points on shore. There are certain considerations which, if observed, are helpful in determining the field's area:

It is well, when possible, to keep the sewage flow constant during the course of the survey so that dilution factors and spread of the field will not be influenced by changing quantities of sewage. It is also well to determine the ammonia content of the sewage effluent reaching the ocean or the field during the course of the survey, so that dilutions may be checked with greater accuracy. A clear day, when the sampling boat can be easily seen from the shore and vice versa, is essential, and it is best that the sea be not overly rough since, in the instance of the White Point Outfall, the outlet is in the open ocean and the survey is usually conducted by landlubbers, some of whom are likely to be seasick. The sector shaped field is most easily traced, therefore it is usually a more successful survey if there is a current running.

The boat proceeds to the sewage field from the harbor and immediately runs seaward from the outlet a half mile or so to obtain clean sea water with which to set ammonia standard samples. Sewage which is most likely to be that reaching the sea during the survey, or sewage of approximately the same ammonia content, is used in the standards. Following this, the boat skirts along the shore side of the visible field taking samples for the determination of bacterial population. During this sampling the boat stays well inshore of the visible line of demarcation between the sewage field itself and the uncontaminated water between the field and the shore.

While picking up samples along the inner border of the field of contamination, the position of the boat as each sample is taken is determined from two fixed points on shore, both stations immediately signaling from shore to boat at each station. A plotter aboard ship locates the latter

Sampling and Plotting Crew
(*Left to Right*)

1—*E. A. Griggs*
2—*A. P. Banta*
3—*R. Pomeroy*
4—*H. K. Palmer**
5—*F. D. Bowlus*
6—*Skipper's Guest*
7—*B. A. Sain*
8—*Another Guest*
9—*Carl Bush*

(**Co-author of this article.*)

on a map of the area in the manner depicted on the accompanying location chart. It has been found that a much better survey is made if those on the boat are constantly aware of their position with respect to the outfall, the field, and the shore. Samples for bacterial analysis are not important on the seaward side of the field because the extent in that direction is not material. The seaward edge of the field is determined later as the boat cuts across the field, selecting samples before it reaches the outer edge and after it leaves it on the shoreward side.

Determining Direction and Velocity of Ocean Current

The boat then proceeds to the zone of turbulence over the rising column of mixed sewage and sea water. These three floats, which are clearly distinguishable from the shore and from one another, are released. One float is released in the zone of turbulence, the second a few hundred feet seaward of it, and the third a few hundred feet toward shore. These floats are released after a reconnaissance of the field has indicated its general direction and extent. The floats are observed from the boat from time to time and their positions at known time intervals are observed and recorded from shore upon signal from the boat. From these observations the velocity of the ocean current is determined and, likewise, its general direction and extent during the survey is revealed. By observation of the three floats it is also possible to determine the relative velocity of travel of the thin sheet of mixed sewage and sea water over the surface of the sea.

A number of samples are taken at the zone of turbulence at the time the floats are released and at other times as occasion offers during the survey. The position of the boat is recorded from shore every time anything which has a bearing on the survey is done from the boat. The record is taken upon signal from the boat and the position of the boat from each point of observation is immediately signaled back to the individual on board who is plotting the boat's position on the location chart previously referred to.

The boat now proceeds to a point well outside of the outer border of the field of contamination or pollution, as indicated by the line of demarcation between the sewage field and the clear sea water. Lining up with certain landmarks on shore, it proceeds toward shore, and at fixed intervals samples of the water are selected and ammonia determination made. If the field is in the shape of a sector, the direction of the boat is such that its path toward shore cuts directly across the current and the field. The operation is likewise designed to determine the borders of the field of contamination, no matter what its shape may be.

As soon as it is apparent that the boat is well inside of inner border of the sewage field, another sample is taken for bacterial analysis, and the boat cuts back out to sea, proceeds downstream a short distance, and again heads for shore, cutting across the field. The procedure in this instance is the same as the first. Samples are taken for ammonia concentration and finally for determining bacterial population as the boat leaves the shoreward side of the apparent field.

This procedure is continued as long as it is apparent that there is any possibility of sewage contamination. Finally, when it appears that the down current end of the field has been reached, the boat proceeds upon another reconnaissance, taking samples at random upstream from and in the vicinity of the zone of turbulence both toward and away from shore.

During all of this, the plotter on board the boat has been spotting the position of the boat at the time each sample is taken or whenever any important operation is going on aboard. An inspection of his record, as plotted aboard ship, indicates clearly to whoever is in charge of the survey, what ground has been covered, whether or not the field has been investigated thoroughly and completely, and if all desired observations have been made or taken.

The boat then proceeds to harbor and the remaining part of the job consists of the analysis of the samples for bacterial population and plotting of the field in the office.

A boat, two transits, thirteen men, and all of the necessary paraphernalia for making float tests and setting and incubating samples are required for the job. With too small a crew progress is too markedly impeded. In fact, it usually is advisable to have one or two extra men along to take the place of those who may become seasick.

References

(1) American Society of Civil Engineers (Paper No. 1750). *Transactions*, Volume 94; p. 1036—1930.

(2) *Journal du conseil Permanent international pour l'expiration de la mir*. Volume 9, No. 1, page 15 to 27—1934.

Incodel

A Decade of Planned Progress

The Interstate Commission on the Delaware River Basin, better known as Incodel, has completed ten years of existence and progress and has published an anniversary booklet commemorating that "decade of planned progress."

The booklet is divided into nine sections: water pollution, water supply, water conservation, Schuylkill River restoration, flood control and navigation, soil conservation and forestation, federal-state relations, state-local relations, and miscellaneous activities.

The book points out that one of the outstanding achievements in water pollution control was the adoption of the agreement for interstate correction and control of the interstate Delaware River. Since the adoption of the plan, 47 communities have built sewage collection and treatment facilities.

After three years' study the states reached agreement as to the use by them of the Delaware River for water supply purposes. During the war, water conservation efforts in the Philadelphia area alone reduced water consumption by 30 mgd.

Restoration of the Schuylkill River is now under way with a planned expenditure of 34 million, of which the State of Pennsylvania is to pay 15 million, the coal operators 6 million, and the Federal government 13 million.

Incodel has been a leader in diverting the moves for Federal centralization of control of waterways and stream pollution, and has worked toward harmonious solution of state and local problems. Studies of the effect of the proposed New Jersey ship canal have indicated that such a canal would jeopardize the use of the Delaware River for public water supplies. The Commission has also studied the salinity of the Delaware, flood control, reforestation, and multiple purpose reservoirs. Several publications dealing with all of these problems in more detail are available from the Commission's office in Philadelphia. James H. Allen is Secretary and Chief Engr. of Incodel.

BIO-FILTER OPERATION AT KEESLER FIELD, MISS.

By R. W. SIMPSON*
Sanitary Engineer
GILBERT ASSOCIATES, INC.
READING, PA.

DURING the war emergency, with building materials critical, emphasis was placed on the construction of high-rate filters. Many opinions have been expressed during the past few years, both pro and con, on the relative values of high-rate filter operation compared to the "old reliable and time tested" standard rate filter. Now that information is available from many military installations, operating data beneficial to future design should be forthcoming.

One type of high-rate filter receiving considerable comment has been the Bio-filter, one of which has been in operation at Keesler Field, Miss., for several years. A comprehensive survey of results obtained for two years indicates that at this installation, under certain conditions, results have been better than expected.

It is the purpose of this review to indicate the conditions favorable for efficient operation at this installation. Although some of the conclusions drawn are applicable only to this particular plant, some have broader applications.

The Author

*Formerly Sanitary Engineer, Keesler Field, Mississippi.

Description of Plant

A brief description of the plant will aid in interpretation of the re-

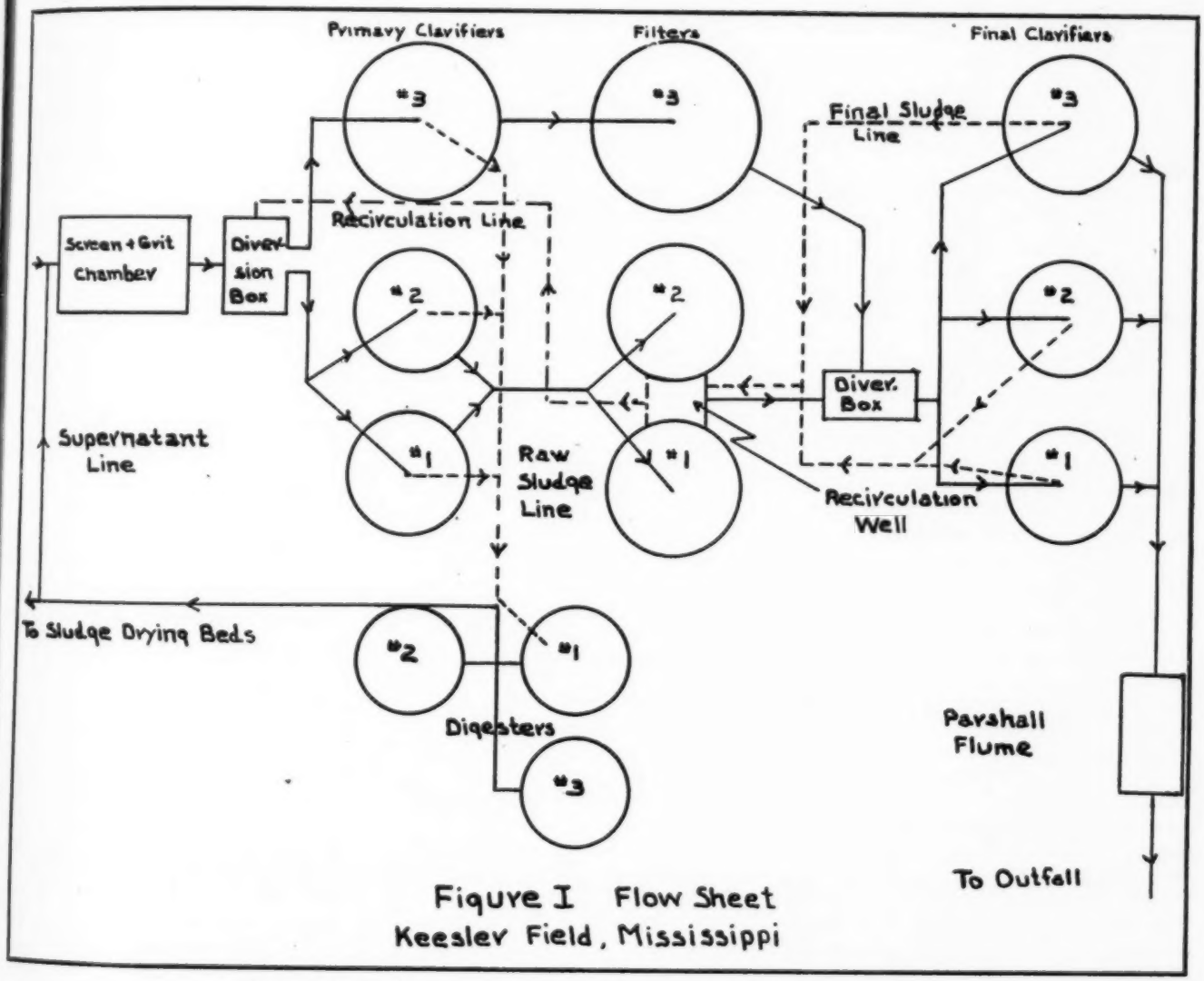


Fig. 1. Flow Diagram—Keesler Field, Miss., Sewage Treatment Plant

TABLE I

Monthly Averages—Operating Data

Month	Flow mgd. Raw Sewage	Flow mgd. Recir. Filter Eff.	Ratio Recirculation to Raw Sew.	Susp. solids ppm. Raw Sewage	Susp. solids ppm. Primary Effluent	Susp. solids ppm. Final Effluent	B.O.D. ppm. Raw Sewage	B.O.D. ppm. Primary Effluent	B.O.D. ppm. Final Effluent	Per Cent Removal Susp. solids Primary	Susp. solids Filter	Susp. solids Total	B.O.D. Primary	B.O.D. Filter	B.O.D. Total
1943															
Jan.	2.01	2.32	1.1:1	218	96	64	214	150	40	56.0	33.4	70.6	29.8	73.8	81.3
Feb.	2.47	2.78	1.1:1	280	120	60	227	180	55	57.1	50.0	78.5	20.7	69.5	75.8
Mar.	2.27	3.00	1.3:1	282	112	42	215	145	30	56.0	64.5	84.7	32.3	80.4	85.9
Apr.	2.73	3.00	1.1:1	288	110	74	256	163	45	60.1	43.6	78.7	38.4	61.8	78.5
May	2.72	3.00	1.1:1	274	117	68	213	139	34	53.7	40.8	73.6	35.4	71.3	83.1
June	2.48	3.00	1.2:1	254	89	47	241	130	32	61.3	46.4	80.1	44.8	72.4	86.3
July	3.22	3.00	0.9:1	313	108	50	229	129	40	65.2	53.7	84.0	43.7	69.0	82.5
Aug.	3.36	2.99	0.9:1	312	112	51	217	122	44	59.2	56.6	83.0	41.6	62.4	78.8
Sept.	3.17	2.95	0.9:1	365	123	70	187	72	40	58.8	47.6	78.7	61.1	35.7	76.2
Oct.	2.94	2.71	0.9:1	386	146	79	208	89	50	58.1	39.4	75.2	54.8	49.4	75.3
Nov.	2.64	2.92	1.1:1	400	115	67	215	99	34	65.6	42.9	81.6	53.5	65.1	84.3
Dec.	2.41	3.00	1.2:1	362	120	61	239	105	26	63.9	49.7	82.1	55.1	73.4	88.7
Avg.	2.70	2.89	1.1:1	311	114	61	222	127	39	59.6	47.3	79.2	43.6	65.3	81.4
1944															
Jan.	2.30	3.63	1.6:1	476	154	63	209	94	21	56.9	57.8	83.6	52.1	77.2	88.9
Feb.	2.25	4.49	2.0:1	405	201	58	251	120	21	45.3	68.3	83.6	52.8	79.7	91.8
Mar.	2.28	4.50	2.0:1	298	159	34	216	114	12	46.3	77.3	87.9	47.6	89.3	94.5
Apr.	2.61	4.47	1.7:1	242	128	35	211	110	15	46.3	71.3	85.5	44.4	86.1	92.6
May	2.65	4.42	1.7:1	311	117	34	232	129	15	58.0	70.2	88.2	42.8	88.9	93.8
June	2.76	4.49	1.6:1	275	102	29	239	118	16	60.1	70.0	88.3	49.9	86.3	93.2
July	2.32	4.48	1.9:1	264	98	35	173	83	7	57.4	78.9	90.9	51.8	91.2	96.1
Aug.	2.20	4.42	2.0:1	233	83	15	142	71	7	60.7	81.0	92.2	51.3	91.1	95.1
Sept.	2.08	4.50	2.2:1	312	96	17	138	65	4	61.8	82.9	92.9	51.5	93.9	96.6
Oct.	1.75	4.31	2.5:1	289	94	24	160	60	7	64.2	71.2	89.5	62.7	87.7	95.1
Nov.	1.79	4.15	2.3:1	263	83	41	146	46	14	65.8	52.2	83.7	69.8	71.2	90.7
Dec.	1.66	4.50	2.7:1	304	98	30	128	31	7	63.8	67.4	88.2	75.2	79.0	95.6
Avg.	2.22	4.36	2.0:1	306	118	34	187	87	12	56.4	70.7	87.9	54.3	85.1	93.7

sults. Fig. 1 is a flow sheet of the plant. Sewage, in a relatively fresh condition, is pumped to the plant from a lift station one mile away. A screen chamber at the head of the grit chamber is manually cleaned. A two channel grit chamber, with adjustable gates, allowing rate of flow control, was added to the plant after the original construction.

To the original installation of two primary clarifiers, two filters, and two final clarifiers, an additional unit of each was added in January, 1943, doubling the size of the original plant. Reference to Fig. 1 will show that the units have been numbered 1, 2 and 3, the number 3 unit in each case being the new addition. The new units have twice the capacity of the original individual units.

A diversion box, with adjustable gates, precedes the clarifiers, allowing flexibility of operation. Raw sewage, discharging from the grit chamber, can be diverted to the old or new sections of the plant. The effluent from the No. 1 and No. 2 clarifiers flows by gravity to the No. 1 and No. 2 filters; the effluent from the No. 3 clarifier can only flow to the No. 3 filter.

The effluent from filters Nos. 1 and 2 is pumped back to the diversion box, where it is mixed with the raw sewage. Again, flexibility allows this recirculated filter effluent to be diverted in the same manner in which the raw sewage is divided. The filter effluent reaches the final diversion box, from which it flows to the final clarifiers.

The effluent from the final clarifiers passes through a Parshall flume and then to the out-fall line. Chlorination equipment has been installed at this point. Contact time for chlorination is provided by the 1½ mile out-fall line.

Raw sludge collected in the primary clarifiers is then pumped to the primary digester, equipped with a sludge mixer, by means of a Barnes sludge pump.

Final sludge flows by gravity to a collecting well, from which it is pumped into the recirculation well to be returned to the primary clarifiers.

Sludge is transferred from the primary digester to the secondary digesters by displacement. A sludge pump is available for transferring and mixing sludge in the digester when necessary.

All mechanical equipment, including sludge collectors, mixers and pumps, as well as the rotary distributors, are of Dorr manufacture.

Experiments With Two-Stage Operation

Although the plant was designed for straight line operation, examination of the flow diagram will show that the plant additions, designated as units No. 3, operate independently of the other units. No recirculation of the filter effluent from No. 3 filter is possible. For this reason, two-stage operation was tried as an experiment.

Since the plant was not specifically designed for two-stage operation, operating problems were encountered. The first stage filters removed most of the organic matter, tending to starve the second stage filter growth, resulting in a very thin film. The clarifier designated as No. 3 in the flow diagram had become a secondary clarifier. The excessive detention in this clarifier also reduced the amount of organic matter available for feed-

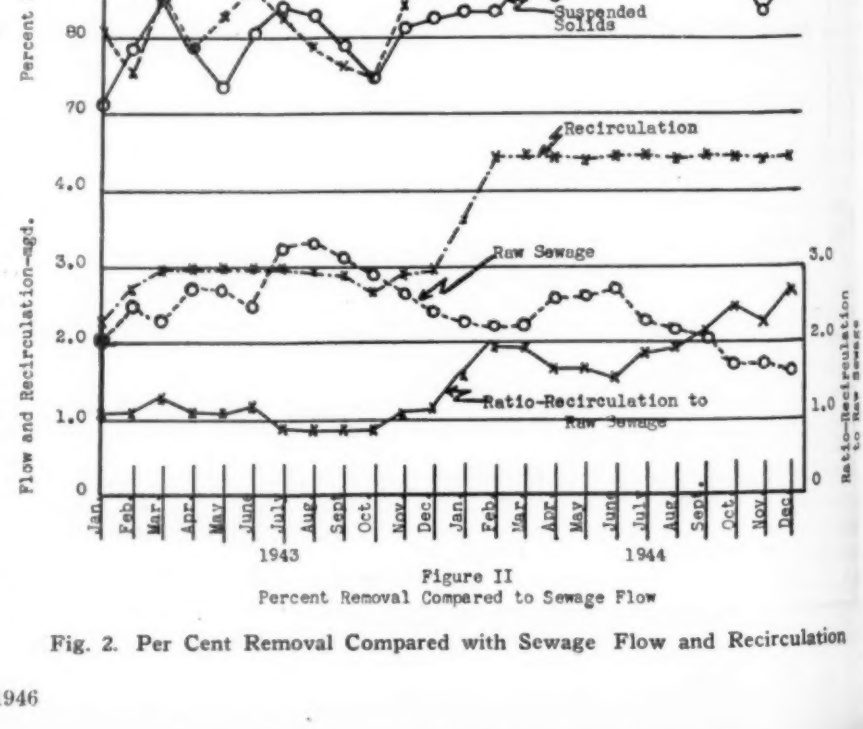


Figure II
Percent Removal Compared to Sewage Flow

Fig. 2. Per Cent Removal Compared with Sewage Flow and Recirculation

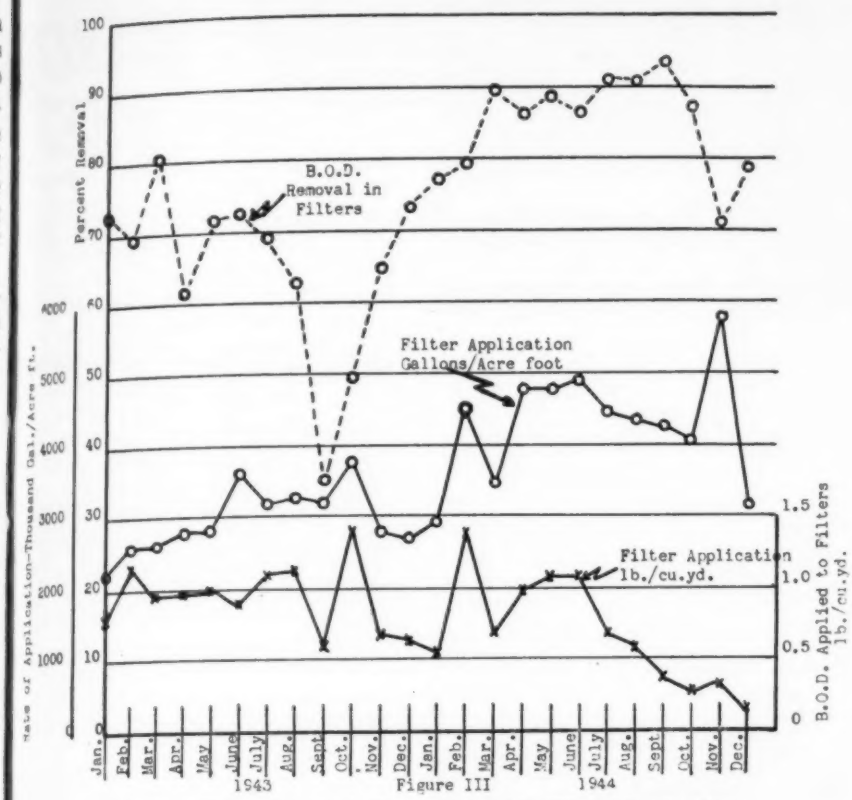

Percent Removal
B.O.D. Removal in Filters
Filter Application Gallons/Acre foot
Filter Application lb./cu.yd.
B.O.D. Applied to Filters lb./cu.yd.
Rate of Application-Thousand Gal./Acre ft.
Jan. Feb. Mar. Apr. May June July Aug. Sept Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept Oct. Nov. Dec.
1943
1944
Figure III

Fig. 3. B.O.D. Removal Compared with Filter Application

ing the growth on the secondary filter. Two-stage operation was discontinued after approximately three months of operation.

Combination Single-Two-Stage Operation

Operating data indicates that a combination single-two-stage method gave the best results. In this case, two-thirds of the raw sewage flow with approximately one-third of the recirculated filter effluent is directed to one-half of the plant (units 1 and 2). The balance of raw sewage and recirculated filter effluent is directed to the other half of the plant (unit 3). With this division of load, the growth on all three filters thrived.

Plant Changes Improve Operation

Many improvements were made in the plant to facilitate operation. Originally, flow into the grit chamber and into the diversion wells was controlled by transite gates in recessed slots in the concrete, with the only control possible either "open" or "closed." In order to control the flow, steel frames were made to slip in the recessed slots. Steel gates of different widths for varying the flow were provided. By selecting the proper gate and inserting it in the frame, it was then possible to divert any portion of the raw sewage flow or recirculated filter effluent to any well, making possible the method of operation now in effect.

Two of the original distributor arms had narrow flat plates the entire length of the arm, above and below the orifices for distribution of primary effluent on the filter media. Over a long period of time, a streaming effect was noticed, with rings of growth on the filter stone. By removing the top plate on the distributor arm and installing sheet metal plates cut in scallops with the outside edge turned up, excellent distribution of sewage over the filter media was obtained. With the streaming effect eliminated and even distribution provided, the filter growth improved considerably. An additional orifice was installed at the inside end of each filter arm to allow better distribution of sewage over the stone in the center of the filter, thereby reducing filter fly breeding in that section of the filter.

In order to overcome the ever present digester scum problem, a standpipe was erected to the top of the digesters, with valves and flexible hose provided, so that sludge could be pumped from any digester up over the scum to soften it up. As long as the scum was kept soft, digestion and settling took place. It was necessary to use this method several times, but in each instance the scum thinned out and completely disappeared shortly thereafter.

No sludge sampling lines were provided in the original installation. The supernatant and sludge lines were tapped and 2-in. connections made, with quick opening valves in-

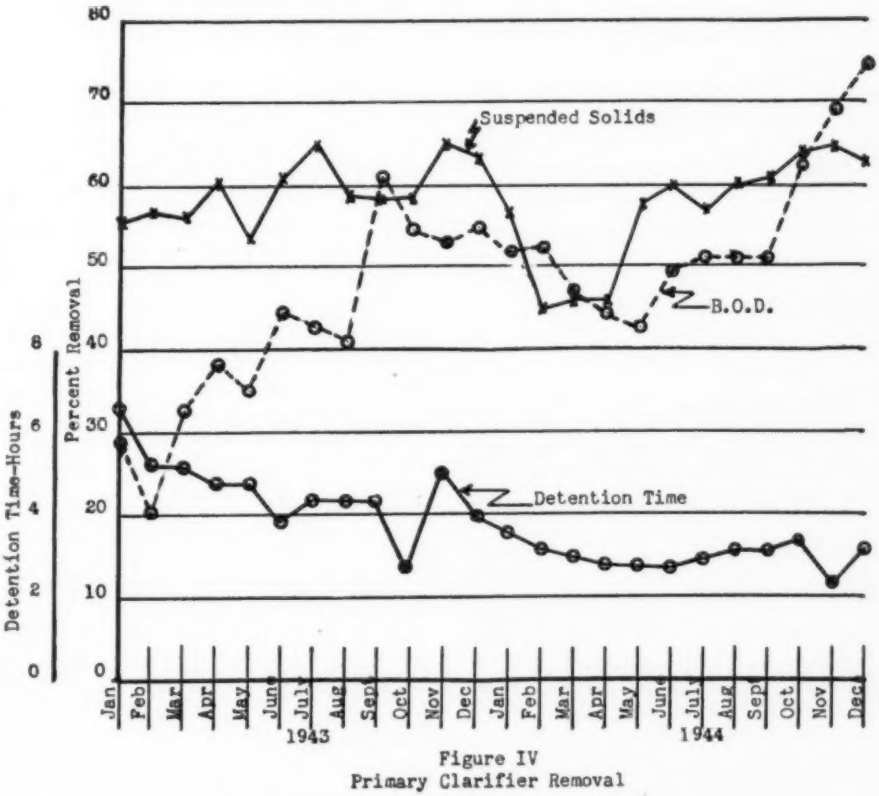
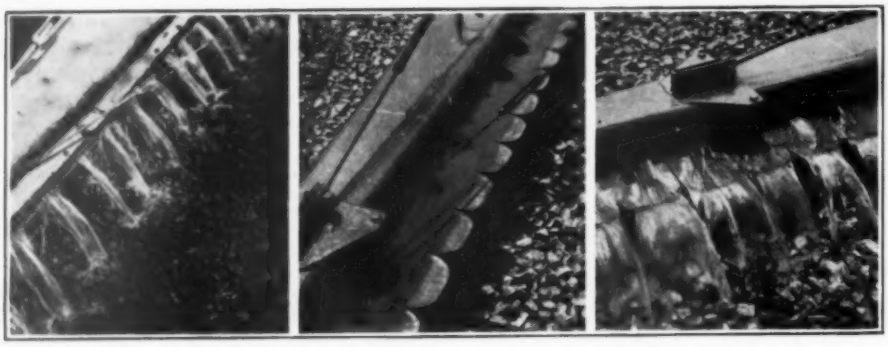

Suspended Solids
B.O.D.
Detention Time
Percent Removal
Detention Time-Hours
Jan Feb Mar Apr May June July Aug Sep Oct Nov Dec Jan Feb Mar Apr May June July Aug Sep Oct Nov Dec
1943
1944
Figure IV
Primary Clarifier Removal

Fig. 4. Primary Clarifier Operation Results



Distribution of Sewage to Filter

Before *The Remedy* *After*

stalled. It was then possible to sample, from these valves, any sludge or supernatant liquor being handled, facilitating operation considerably.

In order to operate the plant as efficiently as possible, a laboratory is available for complete sanitary chemical analysis of sewage and sludge. Samples are taken hourly and composited according to flow over a 24-hour period. Results of these daily analyses are used in controlling plant operation.

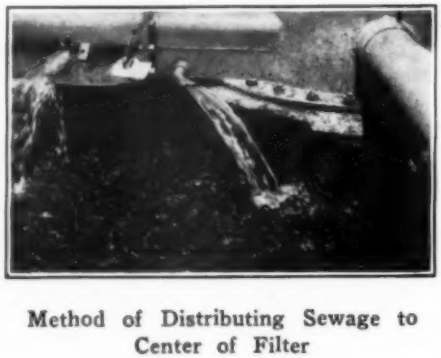
Monthly Operating Data

Monthly averages of operating data are shown in Table I. Examination of these results indicate that during 1943, when the ratio of recirculation to raw sewage averaged 1.1:1, the average suspended solids removal was 79.2 per cent and the B.O.D. removal 81.4 per cent. When recirculation was increased in 1944, both suspended solids and B.O.D. removal increased considerably, as is shown graphically in Fig. 2, which gives the relation of flow data and recirculation to suspended solids and B.O.D. removal. The greatest increase took place in the B.O.D. removal, indicating that for efficient operation and B.O.D. removal greater than 85 per cent, a recirculation ratio of 2:1 is necessary.

Factors Affecting Operation

The most important factors influencing operation of a Bio-filter plant are rate of application to the filter in gallons per acre foot and pounds of B.O.D. applied per cubic yard. Operating data at Keesler Field for two years are shown graphically in Fig. 3. By examination of these data, it will be noted that as the rate of application to the filter increases, the removal of B.O.D. increases. B.O.D. load applied to the filter at this installation is much lower than designed loading. Fig. 3 indicates that reduction in B.O.D. application does not alter the removal by the filter, although it reduces the amount of food available for the biological growth.

It has been stated that one advantage of high rate filter operation is the absence of filter flies, due to the high rate of application to the filter media. High rate application tends to wash the larvae through the filter,



Method of Distributing Sewage to Center of Filter

rather than allow them to grow in the voids under the stones, but this appears to be true only when the application *is* rather high. Results at Keesler Field indicate that in order to prevent fly breeding, it was necessary to maintain a minimum application on the filter of approximately 3 mgd. per acre foot. This rate of application had to be maintained over a 24 hour period or flies bred when the flow was reduced. Converting this figure to one more applicable to other plants, it would amount to an application of 12 mil. gal. acre/day.

It would be normally expected that higher rates of application to the filter would increase the sloughing off and decrease the suspended solids removal. This was not the case at this plant. The improvement in the distributor arms improved distribution and growth to such an extent that with increased applications, the suspended solids removal increased 23.4 per cent in 1944 over 1943, while B.O.D. removal increased 19.8 per cent.

Detention Time

Detention time, while important in all types of treatment plants, is especially important in Bio-filter installations. Examination of the data in Table I indicates that suspended solids reduction in the primary clarifier dropped 3.2 per cent in 1944, while B.O.D. reduction in the primary clarifier increased 10.7 per cent. Fig. 4 shows the relation of detention time to suspended solids and B.O.D. removal. With the increase in recirculation in 1944, the detention time in the primary clarifier was reduced from an average of 4.5 hr. of 1943 to 3.0 hr. The beneficial results from this reduction in detention time are immediately apparent in Fig. 4. With only a slight decrease in suspended solids removal, a definite increase in B.O.D. removal was possible. At the same time, since septicity in the primary clarifier was reduced, final sludge recirculated to the primaries stopped bulking to the surface.

Summary and Conclusions

1. Under controlled conditions, results obtained from Bio-filter operation are excellent, but the ratio of recirculation to raw sewage will vary with each individual installation. At this particular plant, a ratio of at least 2:1 was necessary for efficient operation.

2. Filter flies were controlled at this plant when the rate of application to the filter was greater than 3.0 mgd. per acre foot, i.e., an application of 12 mil. gal./acre/day.

3. Rate of application of B.O.D. to the filter does not appreciably affect operation within the range varying from 0.2 to 1.4 lb. B.O.D. per cu. yd. per day.

4. Maintenance of even distribution of sewage on the filter media is essential to efficient operation.

5. Detention time in the clarifiers is very important. Data indicate that when the detention time in the primary clarifier is greater than 3.0 hours, B.O.D. removals decrease, while very little increased suspended solids removal is obtained.

6. In designing a Bio-filter plant, rate of application to the filter, recirculation ratios, and detention time in the clarifiers are of utmost importance. In order to obtain maximum efficiency from a Bio-filter plant, sufficient flexibility in operation should be possible in order to vary operating procedures.

TWENTIETH ANNUAL CONVENTION OHIO CONFERENCE ON SEWAGE TREATMENT

WITH a registration of 107, nine technical papers, several discussions, two movies, a magician, and a talk on the atom bomb, the twentieth annual meeting of the Ohio Conference on Sewage Treatment was successfully held at Akron on June 20-21. The motion pictures which concluded the sessions were "Concrete Facts," a thirty minute sound film about concrete work by the Master Builders Co. of Cleveland, O., and "Clean Waters," the anti-stream pollution picture produced by the General Electric Co., Schenectady, N. Y.

Chairmen

Incoming
L. C. Huffman
Supt. Sew. Tr.
Dayton, O.

Outgoing
D. D. Heffelfinger
Supt. Sew. Tr.
Alliance, O.

The guest speaker at the annual dinner was Dr. William L. Davidson, Jr., of the B. F. Goodrich Co., Akron. Dr. Davidson, who was a part of the famed Manhattan Project, gave a very lucid explanation of "Atomic Energy," its source, its control, and its effects.

Business Meeting

L. B. "Barney" Barnes reported, as Secy-Treas., the fact that the Association was now $581 in the black, and had a total membership of 135, of whom 28 were new members this past year. There were several additional new members signed up at the meeting.

New officers elected for the ensuing year were:

Chairman
L. C. Huffman,
Supt. Sew. Tr.
Dayton, Ohio

Vice Chairman
L. B. Barnes
Supt. Sew. Tr.
Bowling Green, Ohio

Secretary-Treasurer
G. A. Hall
State Dept. of Health
Columbus, Ohio

Discussion Leaders

Reports
J. J. Wirts Jr.
Supt. Easterly Plt.
Cleveland, O.

Digestion
M. W. Tatlock
Cons. Engr.
Dayton, O.

Best Report
T. C. Schaetzle
Supt. Sew. Tr.
Akron, O.

Fed. V. Pres.
F. S. Friel
Cons. Engr.
Philadelphia

To receive the annual award for the best operating report of the year, the committee chose **T. C. Schaetzle**, Senior Assoc. Engineer, Dept. of Public Works, Akron, Ohio.

Operation Reports

"By law the Ohio Department of Health has required the submission of monthly reports of operation covering each municipal sewage treatment plant," according to **G. A. Hall**, Asst. Engr., Ohio Department of Health, Columbus. In Mr. Hall's paper on "Reports of Operation of Sewage Treatment Plants in Ohio," it was stated that there are 201 sewage treatment plants serving 232 cities in the state; 68 have primary treatment, 9 have primary treatment and chemical coagulation, and 124 have complete treatment.

Mr. Hall gave six reasons for keeping monthly reports:

(1) The recorded results serve as a practical guide for the operator.
(2) The data afford a measure of plant performance.
(3) Monthly reports provide an historical record.

Sec'y-Treas.
G. A. Hall
Asst. Engr.
Ohio Dept. Health

Fed. Director
A. H. Niles
Supt. Sew. Tr.
Toledo, O.

(4) They provide evidence of plant operation in case of complaint.
(5) The data provide a basis for establishing appropriations.
(6) The results are a means for determining the need for improvements.

In his presentation, Mr. Hall discussed such items as reliability of records, including intellectual and professional honesty; data required; report forms; shortcomings noted in reports; and suggestions for improving reports.

In the discussion of Mr. Hall's paper, John J. Wirts, Sup't. of the Cleveland Easterly Sewage Treatment Plant, gave a number of practical suggestions, particularly where several copies of the annual report are needed. Mr. Wirts suggests:

(1) Use a good grade of paper; seventy pound book stock is good for mimeographing.
(2) Use standard 8½ x 11 inch paper, with cover stock slightly larger.

Sludge Digestion

H. A. Schlenz
V. P. & Gen. Mgr.
Pac. Flush Tk. Co.
Chicago, Ill.

Dr. A. M. Buswell
Chief
State Water Survey
Urbana, Ill.

(3) Don't reproduce tables, charts, or flow sheets sideways.
(4) Don't include large blueprints etc. that have to be folded.
(5) Don't wait until January to assemble the annual report; make monthly entries regularly.
(6) Don't present chemical analyses unless you have standard laboratory solutions.

Dual Disposal

In the absence of Morris M. Cohn, Editor, *Sewage Works Engineering*, his paper on "The Sewer Can Serve a Dual Purpose" was read by **T. C. Schaetzle** of Akron. Mr. Cohn's paper described the advantages of the home garbage grinding unit, its operation, and its future. Operating with approximately 1 gal. per cap. per day of water, it introduces into the sewage some 0.5 lb. per cap. per day of suspended solids and

Programmers

F. L. Rollins
Operator
Akron, O.

F. D. Stewart
Asst. Ch. Engr.,
Ohio Health Dept.

about 25 per cent more B.O.D. per person than ordinary domestic sanitary wastes.

Mr. Cohn's paper cited some figures to show that at the normal expected rate of installation of these home garbage grinders within the next ten years, there would be little increase in load on sewage treatment plants. No additions will be required for handling the garbage itself.

In conducting the discussion of the subject of garbage disposal with sewage, **W. H. Knox**, Principal Asst. Engineer, Ohio Dept. of Health, said he was not worried about a sudden increase in sewage plant loadings because of garbage, but for the future, dual disposal does deserve some consideration in design. If the plant is to receive only household ground garbage, that is one thing, but grinding garbage at the sewage plant is another.

Ben Barton of Findlay, Ohio, says that garbage creates a fly hazard when ground at the plant, but he believes that dual disposal is economical, thorough, and cleaner than the present methods of incineration or sanitary fill.

C. C. Hommon of Canton said that

Discussion Leaders

Activated Sludge
E. E. Smith
Supt. Sew. Tr.
Lima, O.

Garbage Disposal
W. H. Knox
Prin. Engr.
Ohio Health Dept.

his city was planning on changing from its present hog feeding method of disposal to dual disposal with the garbage being ground at the sewage plant. Charges will be 50 cents per home per month with an annual charge of $1.00 additional. It is believed these charges will pay for engineering costs to handle the garbage at the sewage plant. Where home grinders are used the charge per house will be $3.50 per year.

Prof. Don E. Bloodgood, of Purdue University, said that in his study of sewer ordinances he had found that the majority prohibit garbage being disposed of to the sewers.

Oils and Greases

Messrs. **F. L. Rollins** and **Geo. S. Long** of the Sewage Treatment plant of Akron presented a paper on "Oils and Greases—Their Effects on Sewage Treatment." In this paper the authors defined grease chemically and noted that its sources were from domestic wastes, industrial wastes, and automotive wastes.

Floating greases and oils cause all kinds of trouble, the amount will

Activated Sludge
Prof. D. Bloodgood
Purdue Univ.
Lafayette, Ind.

Industrial Waste
Dr. Geo. E. Symons
Asso. Editor
Water & Sewage Works

vary, and the method of removing or disposing of it will likewise vary in different plants. Noting that grease, but not mineral oil, will digest, the authors cited the practice at Akron, (skimmed and limed in grit dumps), New York and Chicago, (skimmed and sold). In the United States, a quarter of a pound of grease per month will yield 20,000,000 lb. per month of which 750,000 lb. is saponifiable.

In discussing this paper, **A. H. Niles,** Supt. of Sewage Treatment in Toledo, Ohio, said that in 1941 the grease content of Toledo sewage began to increase markedly, mostly coolant greases from machine manufacturing operations. It was necessary to set up one clarifier just for grease removal by skimming. The result of this grease load was to increase the ether soluble content of the digested sludge

Programmers

Maj. F. D. Martini
U. S. P. H. S.
Washington
D. C.

Paul Beck
Chemist
Rocky River
Ohio

to 35.8 per cent in a total volatile matter content of 70 per cent. Only four per cent of the grease in the sludge was saponifiable.

For the future, said Mr. Niles, it is planned to put in preaeration (following the detritors) for oil separation and remove the grease to be burned.

Mr. Schaetzle of Akron suggested that the Federation of Sewage Works Associations should set up a fund to study the problem of grease in sewage.

Sludge Digestion

"Important Considerations in Sludge Digestion" was a correlated discussion by **Harry E. Schlenz**, Vice Pres. and Sales Manager of the Pacific Flush Tank Co., Chicago, and **Dr. A. M. Buswell,** Chief, Illinois State Water Survey, Urbana, Ill.

Mr. Schlenz pointed out that digestion is dependent on biological action, and that some control of digesters is necessary to obtain the best results from this biological

activity. Practical digester control is dependent on the maintenance of proper digestion balance which means proper balance between sludge additions, sludge withdrawals, and sludge transfer, in the case of two stage digestion. Also important to proper control is the maintenance of proper temperature of the tanks, as well as the maintenance of proper pH. Mr. Schlenz is firm in his conviction, however, that lime should not be used to maintain pH.

Volatile acid control has been employed successfully to foretell the approach of retarding digestion conditions. If the volatile acids rise toward 2000 ppm. the raw solids input should be reduced, or lower volatile acid content liquor should be circulated in the tank.

Scum should be controlled, preferably by recirculation of sludge tank liquor to the surface of the scum and by keeping the temperature of the scum up to that of the sludge compartment.

Foaming generally results from a lay-over of sludge solids which later become violently active. Volatile acid control will aid in this condition also.

For supernatant liquor removal Mr. Schlenz recommends a system whereby the liquor withdrawn from the tank has a minimum of sludge solids in it. Mr. Schlenz exhibited several diagrams to show design arrangements to effect these various means of control mentioned.

Dr. Buswell began his part of the discussion of the topic with the basic questions of why sewage is treated—to eliminate nuisance. The nuisance is caused by bacterial action on organic matter because in the presence of sulphates such activity causes the reduction of the sulfates to sulfides which are odorous.

To prevent this, sewage treatment employs aerobic processes which produce carbon dioxide and water or anaerobic processes (digestion) which produce carbon dioxide and methane, which cannot react with sulfates to reduce them.

From this basic observation Dr. Buswell went on to explain anaerobic fermentation and how bacteria convert complex organic compounds into methane and carbon dioxide. Recent work has isolated, in pure cultures, the organisms which actually do this work. As long ago as 10 years it was known that there were five or six different species of bacteria capable of performing this reaction. Now two species have actually been isolated and further improvement of the process may be a possibility. One of these bacteria is a rod-form (isolated at California) and the other is a sarcina form, isolated at Illinois. In digestion of yeast wastes it is found that the digesters need to be reseeded about every two years.

Inasmuch as these cultures can be dried, and need only a surface to rest on in digestion chambers, and methods of volatile acid control have been developed, pure culture digestion of organic wastes is not far away. Temperature control is important for while the organism may be made to grow at almost any range, including thermophylic, they will not tolerate much change from the temperature to which they have become acclimated. Plus or minus five degrees will greatly reduce fermentation, and a one degree change will actually affect the gas production.

In his discusson of these two papers, **M. W. Tatlock,** Cons. Engr., Dayton, Ohio, raised two questions: "Shall we consider the digester a device for dewatering solids or a device for the destruction of solids? and Do we need supernatant liquor in digestion tanks? If solids are just to be dewatered and only partly destroyed, present sludge digestion practices may be expected to continue, but if digestion for destructive purposes is to be used, then pure culture digestion under controlled conditions is the thing. Under such conditions the whole tank will be active and the liquor removed will be ready for disposal. There will need be no supernatant liquor.

During the open discussion several comments were made to the effect that supernatant liquor should be called *"digester liquor"* for at least two reasons; because it contains too much solids most of the time, and is not supernatant in that it is not above the tank contents. Usually it is a liquid zone of variable concentration existing between the sludge and scum layers.

Six Members of Ohio Sewage Conference

Ben Barton, Supt. Tr., Findlay — *J. M. Turner, Cons. Engr., Columbus* — *A. D. Caster, U. S. Engineers, Columbus* — *G. E. Flowers, Supt. Southerly Treat. Plant, Cleveland* — *Alden Stillson, Cons. Engr., Columbus* — *W. E. Gerdel, Supt. Westerly Treat. Plant, Cleveland*

Military Sewage Plants In Australia

Paul Beck, Chemist, Sewage Treatment Plant, Rocky River, Ohio, had served as a Sanitary Engineer in Australia during the war and had taken a number of pictures of various installations "down under". These and Mr. Beck's comments on sewage practices in Australia were of considerable interest because of the differences from practice in this country.

Stream Water Quality Standards

Maj. F. E. DeMartini, Sanitary Engineer, U. S. Public Health Service, reviewed "Stream Water Quality Standards" from the 3.3 cu. ft. per sec. per 1,000 population proposed by Dr. Hering in 1887 down to the present day standards as presented as the result of the Ohio Stream Pollution Survey. These standards include such criteria as pH, D.O., B.O.D., and bacterial content.

Operators' Certification

The operators' certification program in Ohio was stopped during the war according to **F. Dean Stewart,** Asst. Chief Engr., Ohio Dept.

of Health, who spoke on the "Status of Operator Certification."

The department of health has general supervision of sewage treatment plants in the state and may adopt regulations for their control. One of the regulations adopted in 1937 was to set up operators' certification procedures. It is hoped that new examinations will be ready for September of this year. There are three grades, A and B, both technical, and Grade C, non-technical, and there are 367 outstanding certificates at the present time.

of the cost of handling those wastes in the municipal sewage treatment plant.

"Industrial Wastes—What Are They? They are the problem of Today and they will be the curse of Tomorrow, unless we, to paraphrase Shakespeare, take up arms against a sea of problems and by opposing, end them."

Activated Sludge

In a paper on the "Concentration of Activated Sludge," **Don E. Bloodgood,** Assoc. Prof. Sanitary Engineering, Purdue University, said that all activated sludge had the same characteristic settling curves, with the same characteristic break in spite of the fact that the sludge index varies, the color varies, and the B.O.D. of the sewage varies.

Prof. Bloodgood admonished his listeners not to "hold sludge for a long time in a settling tank if it would not settle in a cylinder."

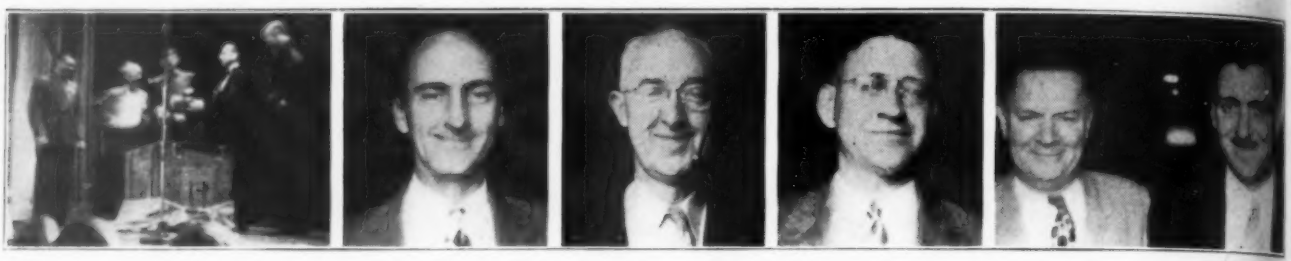
About the causes of bulking, Prof. Bloodgood theorized that excessive food caused excessive growth of bacterial organisms which caused a swelling of the zoogleal mass. At the same time absorption of food by the mass itself will tend to make the mass swell, decrease in density and become bulky.

More oxidation generally helps concentrate sludge and several observers have noted the beneficial effect of chlorination on sludge bulking (See Tapleshay, *Water & Sewage Works,* March 1946, p. 116, and Adams, *Water & Sewage Works,* June 1946, page 240). This chlorine effect may be one of killing off part of the bacterial population and thereby decreasing its activity, or the chlorine may actually tend to shrink the gelatinous mass.

Sludge of certain physical characteristics will not concentrate beyond a certain point unless those physical characteristics are altered to some degree.

Prof. Bloodgood concluded as follows: "The concentration of activated sludge can be controlled by changes in the method of plant operation. Concentrations of activated sludge suitable for immediate discharge to digestion tanks can be obtained in the activated sludge plant. The reciprocal of the sludge index times 100 is the maximum sludge concentration that can be expected from the activated sludge plant. Sludge concentration tanks will give satisfactory results if the sludge can be held in them for a sufficiently long time so that the physical characteristics of the sludge have changed, but it is difficult to operate concentration tanks without odor nuisance."

E. E. Smith, Supt. of Water and Sewage, Lima, Ohio, led off the discussion of the paper with the comment that the effect of aeration on sludge concentration was debatable. Mr. Smith also believes that chlorine has a selective effect on Sphaerotilus. Even a heavy rapidly settling sludge may become "infected" and bulk. Bypassing a part of the load on the aeration tanks is not always possible, although it does, as Prof. Bloodgood says, aid materially in reducing the bulking condition of the sludge.



Shot At the Conference

Magician at Work | *E. F. Wittmer Marion* | *C. D. McGuire Columbus* | *R. F. Snyder Massillon* | *A. F. Paulik and L. R. McCoy Diamond Alkali Co.*

Industrial Waste

A broad and basic definition of industrial wastes was set up by **Dr. George E. Symons,** Assoc. Editor, *Water & Sewage Works,* in his talk entitled, "Industrial Waste—What Is It?"

"Industrial waste is any material or energy discarded by industry in the production of some useful product or service, regardless of whether the discharge is to the atmosphere, to land or to bodies of water, and regardless, too, of whether or not that discharge has any economic value or is in any way deleterious to the receiving medium."

Having a basic and broad definition, it becomes possible to classify wastes according to deleterious nature, recoverable by-products, effect on receiving medium, treatment required, or in any other category that may aid in study of the wastes. From such classifications come the answers to the questions of which wastes to treat, what to recover, cost of treatment and so forth.

Industry must recognize the fact that waste treatment must be considered as part of legitimate production costs, and waste treatment plants as part of the capital structure. Where industrial wastes are discharged to sewers, industry must be prepared to pay its fair share

Federation Affairs

Francis S. Friel, Cons. Engr. of Philadelphia, and Vice Pres. of the Federation of Sewage Works Assns., spoke on the founding of the Federation in 1928 and its growth since reorganization in 1939. There are now 28 member associations in 22 states and several outside the country, and a total membership of more than 3500. Mr. Friel also spoke of the service of the Federation, its office in Champaign, the Sew. Wks. Journal, the manuals of practice, competitions, and the annual meeting, which this year will be held in Toronto, Ontario, Canada, on Oct. 7-9.—(G. E. S.)

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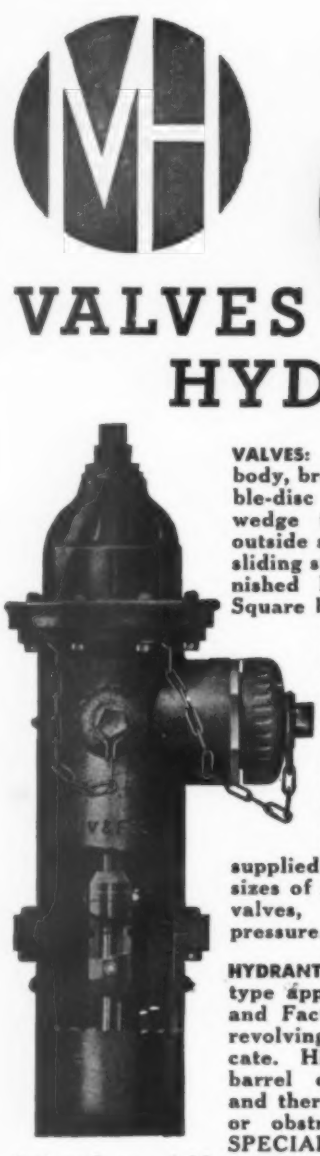

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MEETINGS SCHEDULED:

Sept. 17-20—POLAND SPRING, ME. (Poland Spring House)
New England Water Works Assn. (Annual Meeting). Sec'y, W. C. Conroy, 609 Statler Bldg., Boston, Mass. (On Sept. 16, a pre-convention get-together will be held in the evening.)

Sept. 18-20—TRAVERSE CITY, MICH. (Park Place Hotel)
Michigan Section A.W.W.A. and Conference on Water Purification. (Joint Conference.) Sec'y-Treas., R. J. Faust, Michigan Dept. of Health, Lansing, Mich.

Sept. 20-21—DEADWOOD, S. D.
South Dakota Water & Sewage Works Conference. (Annual Meeting.) Dir. W. W. Towne, Div. of Sanitary Engineering, State Dept. of Health, Pierre, S. D.

Sept. 22-25—FORT WORTH, TEXAS (Hotel Texas)
American Public Works Congress. Exec.-Dir., D. F. Herrick, 1313 East 60th St., Chicago 37, Ill.

Sept. 26-27—MANDAN, N. D. (Hotel Lewis & Clark)
North Dakota Water & Sewage Works Conference. Sec'y-Treas., K. G. Lauster, State Dept. of Health, Bismarck, N. D.

Sept. 27-28—LANCASTER, PA. (Hotel Brunswick)
Four States Section A.W.W.A. Sec'y-Treas., H. Lloyd Nelson, 1624 Lincoln-Liberty Bldg., Philadelphia 7, Pa.

Oct. 3-4—ALBANY, N. Y. (Hotel DeWitt Clinton)
New York Section A.W.W.A. Sec'y-Treas., R. K. Blanchard, 50 West 50th Street, New York, N. Y.

Oct. 7-9—TORONTO, CANADA (Royal York Hotel)
Federation of Sewage Works Assns. Exec.-Sec'y, W. Wisely, 625 Illinois Bldg., Champaign, Ill.
Canadian Institute of Sewage & Sanitation, Sec'y-Treas., Dr. A. E. Berry, Parliament Bldgs., Toronto, Ont.

Oct. 9—BANGOR, ME.
Maine Water Utilities Association. Sec'y, Earle A. Tarr, Supt. Water District, Winthrop, Me.

Oct. 10-12—COLUMBUS, O. (Hotels Fort Hayes — Chittenden)
Ohio Section A.W.W.A. Sec'y-Treas., F. P. Fischer, 811 Perry Payne Bldg., Cleveland, O.

Oct. 14-17—GALVESTON, TEXAS (Hotel Buccaneer)
Southwest Section A.W.W.A. Sec'y-Treas., Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 16-18—ATLANTIC CITY, N. J. (Hotel Traymore)
Pennsylvania Water Works Association. Sec'y-Treas., E. R. Hannum, 510 Telegraph Bldg., Harrisburg, Pa.

Oct. 16-19—KANSAS CITY, MO.
American Society of Civil Engineers. Sec'y & Exec. Officer, William N. Carey, 33 West 39th St., New York, N. Y.

Oct. 17—BOSTON, MASS. (Hotel Statler)
New England Water Works Association. (Executive Committee Meeting.) Sec'y, W. C. Conroy, 609 Statler Bldg., Boston, Mass.

Oct. 17—BOSTON, MASS. (Parker House)
New England Section A.W.W.A. Sec'y, R. H. Ellis, Inspection Dept., Associated Factory Mutual Fire Insurance Co., 184 High St., Boston, Mass.

Oct. 21-22—COLUMBIA, MO. (Daniel Boone Hotel)
Missouri Water & Sewerage Conference. Sec'y-Treas., Warren A. Kramer. State Dept of Health, Jefferson City, Mo.

Oct. 23-25—SAN FRANCISCO, CALIF. (Hotel Whitcomb)
California Section A.W.W.A. Sec'y-Treas., Ray L. Derby, Box 3669 Terminal Annex, Los Angeles 54, Cal.

*Oct. 24-25—HUNTINGTON, W. VA. (Hotel Pritchard)
W. Va. Section A.W.W.A. (Joint Meeting.)
21st Conference on Water Purification. Sec'y, J. H. Harrington, State Dept. of Health, Charleston, W. Va.

*Dates changed.

MEETINGS SCHEDULED:

Oct. 28-30—PITTSBURGH, PA. (Hotel William Penn)
Engineers' Society of Western Penna. (7th Annual Conference.) Chairman, H. M. Olson, Wm. Penn Hotel, Pittsburgh, Pa.

Oct. 28-30—KNOXVILLE, TENN. (Hotel Andrew Johnson)
Kentucky-Tennessee Section A.W.W.A. Sec'y-Treas., R. P. Farrell, Dir. of San. Eng., State Dept. of Health, 420 Sixth Ave. N., Nashville, Tenn.

Nov. 4-6—DES MOINES, IOWA (Hotel Kirkwood)
Iowa Section A.W.W.A. (1st Reorganization Meeting.) Chairman of Comm., H. V. Pedersen, Supt. Water Works, Municipal Bldg., Marshalltown, Iowa.

Nov. 7-9—ATLANTIC CITY, N. J. (Hotel Chelsea)
New Jersey Section A.W.W.A. Sec'y-Treas., C. B. Tygert, Box 178, Newark, N. J.

Nov. 11-15—CLEVELAND, OHIO (Public Auditorium)
American Public Health Association. (74th Annual Meeting.) Exec.-Sec'y, Reginald M. Atwater, 1790 Broadway, New York, N. Y.

Nov. 14—BOSTON, MASS. (Hotel Statler)
New England Water Works Association. Sec'y, W. C. Conroy, 609 Statler Bldg., Boston, Mass.

Nov. 14-15—RICHMOND, VA. (Hotel John Marshall)
Virginia Section A.W.W.A. Sec'y-Treas., W. H. Shewbridge, State Dept. of Health, 1506 Greycourt Ave., Richmond, Va.

Nov. 15-17—GREEN BAY, WIS. (Hotel Northland)
Wisconsin Section A.W.W.A. Sec'y-Treas., L. A. Smith, Supt. of Water, City Hall, Madison 5, Wis.

Nov. 18-20—RALEIGH, N. C. (Carolina Hotel)
North Carolina Section A.W.W.A. (Joint Meeting with) **North Carolina Sewage Works Association.** Sec'y-Treas., (both Assns.) Geo. S. Moore, Box 125, Albemarle, N. C.

(*Continued on Page* 108)

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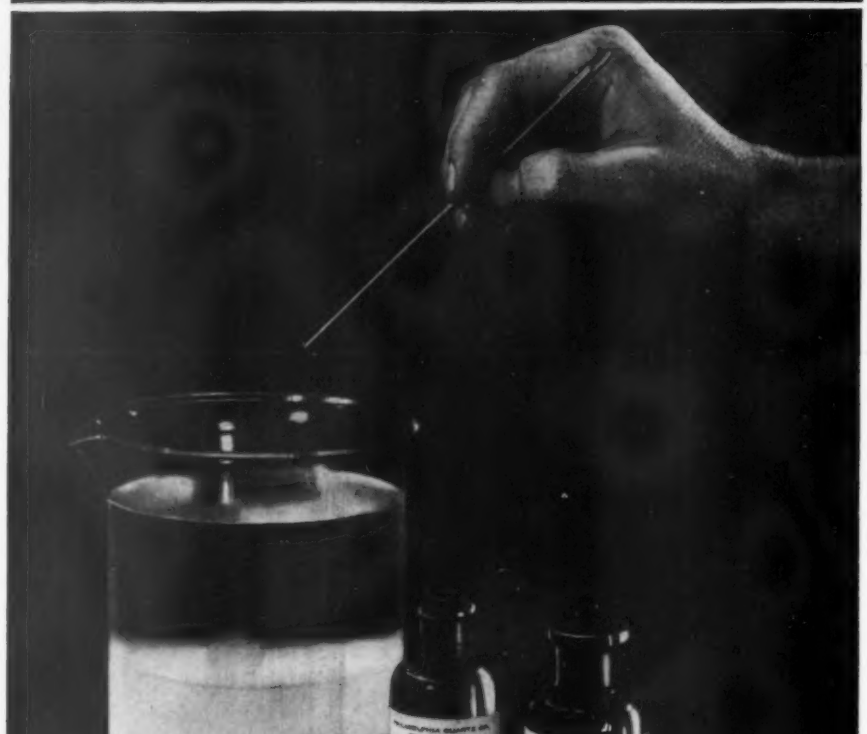

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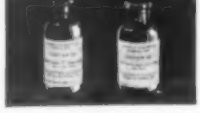

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*Patent Applied For

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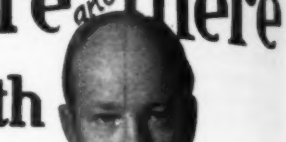


Want to swap something? Browsing through the July issue of *Out of the Spigot*, the So. Car. Water and Sew. Wks. Assn. news letter, I came across this item: "Let's Swap—one 3 cu. ft. incubator and one gas operated water still. Write Joe McCall, Filter Plant Supt., Clemson College, Clemson, S. C." That gives me an idea. How would the readers of this column like to use it as a place to list articles to swap. I'll run one item a month—no charge.

* * *

Dropped out to our local water plant recently and met V. A. Mascia, the operator, who was busily engaged chasing Euglena or some motile algae around his microscope slide, getting ready to copper sulfate his reservoir—the hard way—rowing a boat with sacks tied behind. V. A. recognized me from the picture which adorns this column, in spite of the fact that the hair line has receded farther and the eyes now peer out through two glass windows. How much longer *may* I use that old picture?

* * *

More about my picture taking. This came from Clarence Adams, to whom I sent a copy of a snapshot of him taken at Purdue last Spring. Clarence, who is superintendent of water at New Albany, Ind., wrote: "Thanks for sending the snapshot you took of me. . . . It appears to be a common experience for us, as we wade around in this puddle, which for want of something better, we call Life, to have some energetic fellowman line us up against a wall where with a faint click of a shutter he can make us suddenly realize just what we have done to this ball of clay the Good Lord gave us to pack around for seventy years or more. The impact is all the more excruciating when we realize that the Good Book

says that God made man in His Own Image. I guess a lot of us came along after that happened.

"Here I was refraining from looking in mirrors and basking in the atmosphere created by a fond wife, an admiring son, and three dewey-eyed Setters when along comes that snapshot! Now, I just can't figure out why you went to all that trouble of sorting out my picture from hundreds of others you have snapped, unless it was for consolation on your part to make me aware of the fact that I, too, am getting bald. . . ." Hm-m-m.

* * *

Speaking of pictures. Here's one of a meter panel. Panel of Meter Experts, that is. It was snapped at the N. J. Sect. meeting in New Brunswick last Spring.

Reading from left to right are Dave (Builders-Providence) Purdie, "Dick" (Meter Box) Ford, "Bill" (Worthington-Gamon) Flanders, Shaw (Pitometer) Cole, and Jack (Neptune) Faulks.

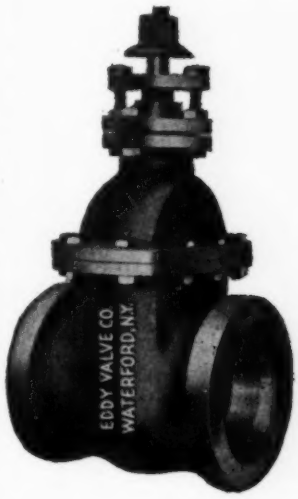
I'm sorry Dave Purdie is a little faint in the picture—but his voice certainly wasn't faint when it came to the answers. Seeing that picture again reminded me that it was Dave who, when it came his turn to talk about water conservation by metering said that up to now most water conservation was just conversation.

* * *

Chats With the Water Man. I've been meaning to tell you about a new column running in *Water*, the house organ of the Amer. Water Works and Elect. Co.; Editor, Florence W. White. The new column, titled "Chats with the Water Man" is "prepared at present by a man who has spent many years in the business . . . with the idea of passing on some facts and fancies about water, one of the most unusual, extraordinary, and mysterious compounds known to science."

I don't know who the columnist is, but his first one on the prevalence of water was mighty interesting. For example, did you know that if the earth were smoothed off to

for permanent satisfaction— specify



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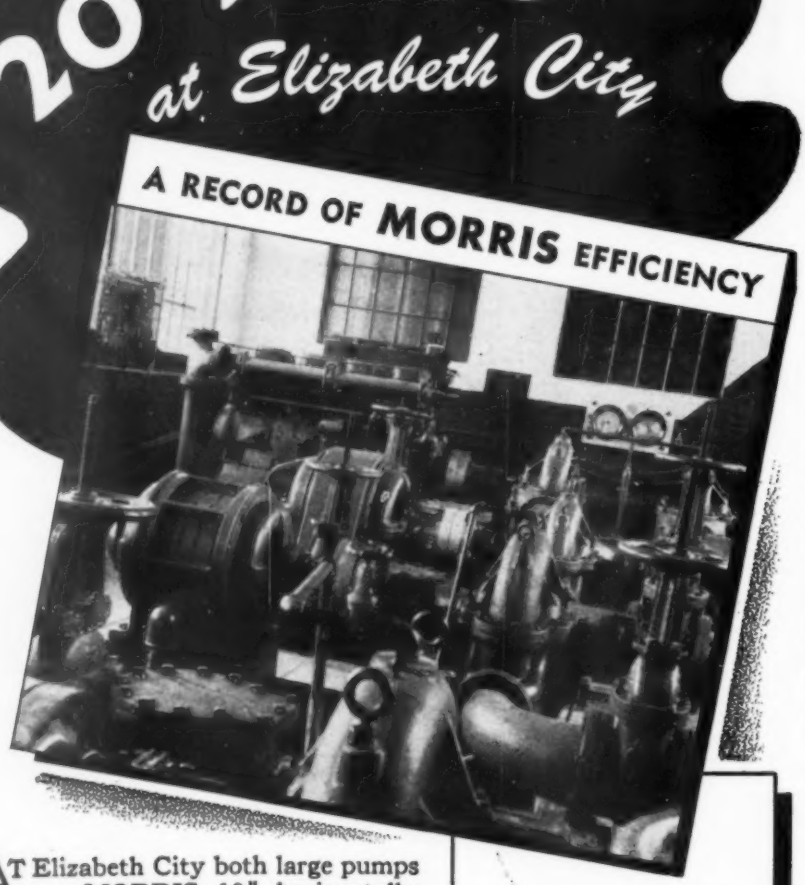

The water supply at Elizabeth City, N. C., built in 1926, utilizes four half-million gallon filters and settling basins, two 2,100 gpm, and two 1,440 gpm Morris pumps for the main pumping units. This plant, contending with an acute salt water problem, has an unique history, significant in the municipal field.

AT Elizabeth City both large pumps are MORRIS 10" horizontally split, double suction, bronze fitted design with 10" suction and 10" discharge openings. The motor driven pump operates against a 160 ft. head and is driven by a 100 HP, 1165 RPM motor. The second large pump also has a 10" suction and discharge opening and was designed for a total head of 240 ft. It is directly connected to a DRC-8 Sterling gasoline engine.

The two smaller pumps are 6" horizontally split, double suction pumps with 6" suction and 6" discharge and were originally designed to pump against variable heads of from 123 ft. to 160 ft. Each of the smaller pumps is directly connected to 50 HP, 1160 RPM motors.

Twenty years of service by these Morris pumps prove the rightness of Morris engineering, that results in maintained efficiency, uninterrupted service and long wear . . . economy in the long run. Eighty-two years of experience in building rugged, long-wearing pumps always pays off.

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MORRIS **CENTRIFUGAL PUMPS**

a perfect sphere with all of the mountains cut down to fill the valleys of the oceans, water would cover the entire surface of the earth to a depth of nearly two miles. And of course you know that most of the foods you eat are largely water; even beef is 62 per cent water. You and I are more than that, brother.

* * *

He knew what he wanted. Most of us probably go to college or enter some profession (such as water and sewage works operation) because of one circumstance or another. Perhaps in the course of years we may drift into something we really feel we were cut out to do. Not so with Len Thompson, Past Pres. of A.W.W.A. He knew what he wanted. As a boy Len wanted to be an engineer, but he didn't know what kind, so he made a list of all the kinds of engineers he had ever heard of: mechanical, structural, electrical, civil, steam, municipal, locomotive, marine, and so on. Then as the school year progressed and he asked questions and learned more about each kind of engineer, he crossed off one by one those he decided he did not want to be. When he had but one left, it was Civil, so Len Thompson studied Civil Engineering. — For which a lot of folks in St. Paul can be thankful.

* * *

It's a little discouraging sometimes. Radio shows and advertisers who want to find out the size of the audience reached use a trick of offering something free — if you will just write in — or some variation of that idea.

So I thought I'd try the same stunt and in July I offered to personally donate one subscription to *W. & S. W.* to the first person who deciphered this addressee on a letter received in our office — to wit: Mr. K. G. Wbakigm Wsurie. — Want to know how many letters I received? Exactly two. Yes, sir, it's a little discouraging sometimes. — Both of the writers, H. E. "Boone" Hudson, Filtration Engr., Chicago Water Bureau (and a onetime student of mine), and John E. Kleinhenz, Public Relations Manager of the Indianapolis Water Co., and movie producer par excellence; both of them, I say, cried "Shame for letting the typographical error creep in, it should have read K. G. Wbakiqm Wsurie." I assure you gen-

tlemen that I did not put the g in place of the q to confuse you. The letter was addressed as I gave it to you.

Who was the first to figure it out? Hudson's letter was postmarked 12 hours earlier than Kleinhenz' but "Boone" admitted that it was his wife "Sophie who figured it out in 30 seconds flat." Having found two such loyal readers (three counting Sophie) I feel that I should reward them both — John has offered to settle for a full sized breakfast when next I'm in Indianapolis, but shall I send the subscription to Mr. or Mrs. H. E. Hudson?

* * *

It was 20 years ago this month that Dr. A. M. Buswell, Chief of the Illinois State Water Survey, at Urbana, Ill., hired two Juniors at the University of Illinois, as student assistants. Homer was a draftsman, and Rusty was an assistant chemist. Who would have guessed that two decades later, both would be making a living from journalistic endeavors. Rusty is a columnist for *Water and Sewage Works* under the name of Doc Symons, and Homer now signs editorials as W. H. Wisely, Editor, *Sewage Works Journal*.

* * *

A letter from C. George Andersen, former Supt. of the Rockville, L. I., activated sludge plant, says he is having FUN in Bermuda. First he had set up the equipment in the sewage treatment plant of the air base, then he had to set up a division of sanitation, garbage collection, and incineration, then supervise both salt and fresh water division, and last but not least supervise bathing beach pollution control. Add to that a high sulfate content in the sea water which gets into the sewage and gives off plenty of H_2S in the digesters, and you have some idea of the *fun* he is having. George says he wears shorts to work and feels quite the wag in them. Wants to be remembered to all his friends and hopes he can get to Toronto.

* * *

Now I know. For some time now I've been suspecting that as a writer of papers for presentation at technical conventions, I had perhaps passed my prime. During the past Spring I appeared on four programs, and each time I was more sure than ever, that my day as a technical speaker had passed. What made me think so?

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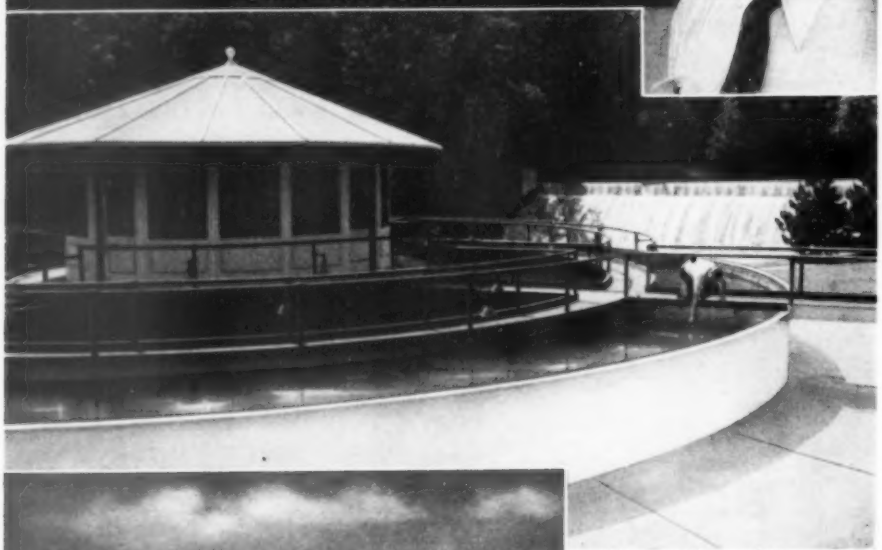

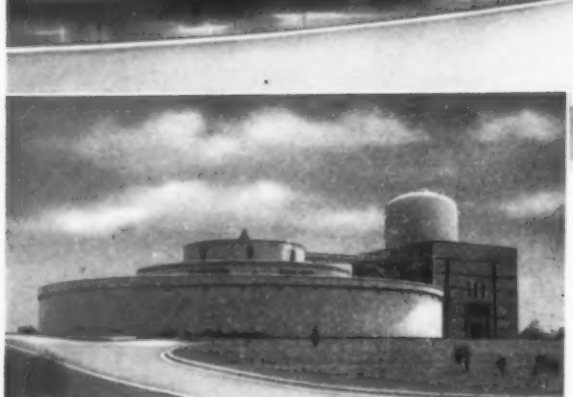

Above—One of the concentric filter assemblies at the Robert B. Morse Filter Plant of Washington Suburban Water Works, Burnt Mills, Md.

Left—New all-steel Willis School Filter Plant serving Washington Suburban. This modern, functionally-designed plant began operation in 1944.

The Maryland suburbs of Washington are served by two of the nation's most up-to-date filter plants, Robert B. Morse and Willis School—and both use Virginia ESOTOO for dechlorination. Matching the modern design of concentric steel filter tanks is the special equipment for accurate control of residual chlorine, assuring Washington suburbanites a constant supply of palatable water.

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— After each talk, not one, but several, persons said to me, "I surely enjoyed your talk." — Now, my friends, people don't enjoy technical talks. They may find such talks interesting, provocative, helpful, or dull, but they don't enjoy them. People only enjoy entertainment. — Sa-a-ay — you know I 'kinda' like the idea of being an entertainer.

[Overflow from the main section]

Annual Report Briefs

Athol, Mass. — Fortieth Annual Report of the Water Commissioners, year ending Dec. 31, 1945, Robt. W. Glasheen, Supt. — Tables show rainfall, filter plant operation, pipe installed, financial statement and 23 year record of water consumption as affected by meter installations. In 1922 when only 79 services were metered, water consumption was 1.193 mgd.; in 1945 with 2134 meters installed (758 new services added in same period) the water consumption was only 702,793 gpd.

Denver, Colo. Report of the Board of Water Commissioners, year ending Dec. 31, 1945, D. D. Gross, Chief Engr. — A 76 page printed report covering all divisions from organization and personnel to water supply. Distribution of operating revenue is graphically shown by shaded portions of a fire hydrant; 29.96 per cent for maintenance and operation, 18.23 per cent for depreciation, 43.07 per cent for interest and bond retirements and 8.74 per cent for invested capital. A pin point map shows new additions made in the city, and a bar graph shows new service installations by years since 1918. Costs of operation of conduits, etc., are detailed by years, as are costs of filter plant operation. Average cost of filtration for all plants was $9.06 per mil. gal. Typhoid statistics since 1887 plotted. No deaths from typhoid since 1943.

Cleveland, Ohio. Report on the Administration, Operation, and Maintenance of the Division of Sewage Disposal, year ending Dec. 31, 1945, J. W. Ellms, Commissioner. A 52 page book covering analytical and operating data tables, and

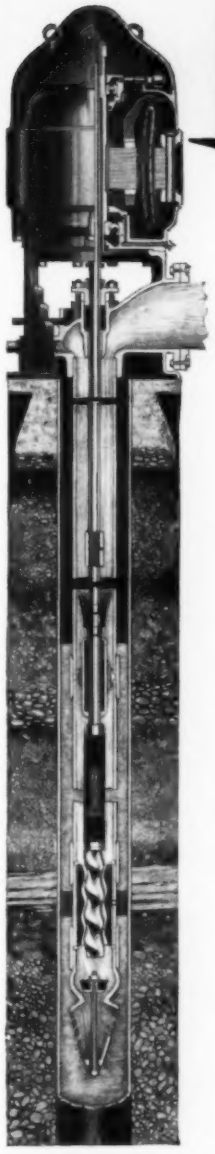
superintendent's reports for Easterly Plant (John J. Wirts, Supt.) Westerly Plant (Walter E. Gerdel, Supt.), and Southerly Plant (G. E. Flowers, Supt.) Flow diagram of Westerly Plant shown with personnel chart. Cost of operation per mil. gal. was as follows: Easterly $17.27, Westerly, $16.96, and Southerly, $16.50.

Elmira, N. Y. Elmira Water Board, year ending Dec. 31, 1945; John G. Copley, Gen. Mgr. A 32 page book with photographs and text on the history of the Elmira Water Supply and the equipment, reservoirs, and facilities. Analyses of raw and finished water, meter rates, and financial statement which shows all bonded indebtedness paid off and some $40,000 a year reduction in service charges to consumers. No typhoid fever deaths since 1942.

Gary, Ind. Fifth Annual Report Sewage Treatment Works, Gary Sanitary District, year ending Dec. 31, 1945, W. W. Mathews, Supt. — A 52 page mimeograph report with 38 tables on plant operation, including gas engine operation, and costs. Description of plant included. Summary of five years shows plant operation consistent with above 90 per cent removal of suspended solids and B.O.D. (Activated Sludge Process). 1945 cost of operation was $0.701 per capita connected. (Population estimated at 100,000. Gas production has been worth 31 per cent of the cost of operation; in 1945 gas produced was worth $22,784.

Hartford, Conn. Fifteenth Annual Report of the Water Bureau, year ending Dec. 31, 1944, Caleb Mills Saville, Manager and Chief Engr.—106 pages plus map of water supply areas. 1944 water dollar shows 46.4 cents for fixed charges, 16.7 cents for depreciation, 12.6 cents for administration and 17.8 cents for operation. Financial tables and charts make up most of the report.

Indianapolis, Ind. Annual report of Sewage Disposal and Garbage Reduction, 1945, W. H. Frazier, Supt. —A 28 page mimeograph report. Contains discussion of grit chambers, clarification, secondary treatment, sludge disposal, river data, cost of operation, garbage reduction, and trash collection. Raw sewage averages 119 gpcd. from a population of 416,000 and cost $0.543 per cap. for treatment, (10.72 per mil. gal. treated or $9.99 per thousand lb. of B.O.D. removed). Sludge



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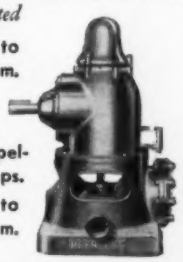

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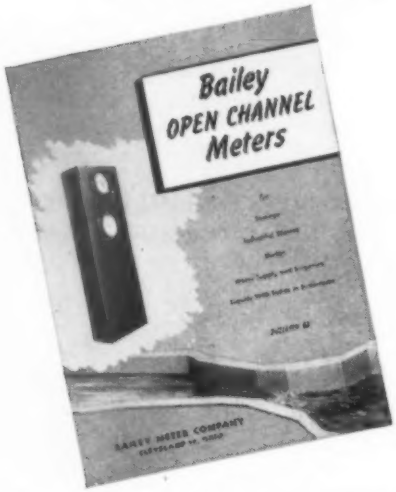

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(*Continued from page* 101)

Nov. 22-24—HAVANA, CUBA (Joint Meeting)
Florida Section A.W.W.A. Sec'y, Dr. A. P. Black, Univ. of Florida, Gainesville, Fla.
Cuban Section A.W.W.A. Sec'y, Laurence H. Daniel, P. O. Box 531, Havana, Cuba.

Dec. 11—AUGUSTA, ME.
Maine Water Utilities Association. Sec'y, Earle A. Tarr, Supt. Water District, Winthrop, Me.

Dec. 19—BOSTON, MASS. (Hotel Statler)
New England Water Works Association. Sec'y-Treas., W. C. Conroy, 609 Statler Bldg., Boston, Mass.

lagoon capacity is growing short. No new method of disposal under consideration.

Jackson, Mich. Annual Report Sewage Treatment Plant; year ending June 30, 1945, A. B. Cameron, Supt.—Flow treatment averaged 8.16 mgd. with 97 per cent removal of B.O.D. and 93.5 per cent removal of suspended solids. Cost of operation, $21.58 per mil. gal.; $36.92 per mil. gal. fixed charges included.

Little Rock, Ark. Tenth Annual Report of the Little Rock Municipal Water Works; year ending Dec. 31, 1945, L. A. Jackson, Manager-Engineer.—An 84 page printed book with 11 illustrations, a history of the water supply, and tables of data and statistics on everything from meterology to analysis of financial surplus. In ten years water rates have been reduced 22 per cent, plant valuation increased 93 per cent, annual revenues increased by 45.8 per cent, number of consumers by 34 per cent, and water processed increased by 70 per cent while water sales have increased 87 per cent. Total direct operating expenses 5.66 cents per 1000 gallons, plus fixed charges of 5.89 cents per 1000 gallons.

New Britain, Conn. Annual Report of the Sewage Disposal Commission of the City of New Britain; year ending March 31, 1946; John R. Szymanski, Supt. and Chief Chemist.—A 28 page mimeograph report. Serves population of 80,000. Average flow 9.95 mgd. Chlorinated copperas or ferrisul plus chlorine used. Guggenheim type activated sludge process. Air consumed 0.13 cu. ft. per gal.; returned sludge 10.3 per cent. Sludge filtered and incinerated. Suspended solids removed 83 per cent, B.O.D. removed 74 per cent. Cost of operation $24.95 per mil. gal.

Orlando, Fla. Annual Report, Orlando Utilities Commission; year ending Dec. 31, 1945; Martin W. Brown, Gen. Mgr.—A 20 page pamphlet prepared for the citizens of Orlando. Filled with easily understandable graphs, charts and pictures that tell the complete story, devoid of detailed tabular data. Theme of the diagrams and graphs is "That You May Know." Covers both electricity and water; shows that earnings of the utilities cuts the city tax rate in half. Management costs were only 45 cents per customer, water pumpage was up 400 mil. gal. for the year. Cost per thousand gallons for pumping and purification was $0.0316.

Urbana-Champaign, Ill. Operation Report for Fiscal Year May 1, 1944 to April 30, 1945; W. M. Kunsch, Engineer-Manager.—A 41 page mimeograph, bound report. Covers description of sewage works, personnel, administration, planning for construction, plant operation data, financial data, maintenance, lists of visitors, and special activities, as well as tables on analytical data. Estimated population 45,000; Avg. flow 3.45 mgd., reduction in suspended solids 83.3 per cent, in B.O.D. 87.2 per cent (trickling filter). Cost of operation of treatment plant — $18.69 per mil. gal. Cost of operation of entire district $25.51 per mil. gal.

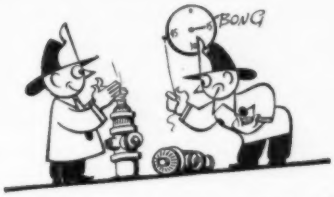
Land's Sake!

"Could it be one of those B. Colis the Water Works Chemist warned us about?"

Water Bacteriology

(A Book Review)

Water Bacteriology (Sixth Edition), by Samuel C. Prescott, Charles-Edward A. Winslow, and MacHarvey McCrady, is a complete revision and enlargement of previous editions which were published under the title, "Elements of Water Bacteriology." For the 6th edition, M. H. McCrady, Chief, Division of Laboratories, Quebec Ministry of Health, joined the senior authors. The result has been a revised edition of practically double its former size. The material on coliform bacteria has been tripled and other significant changes have been made in attention to details of technic.



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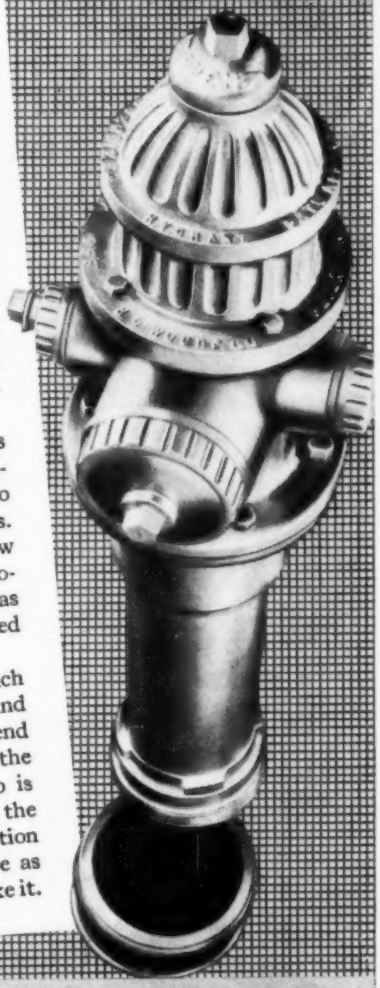

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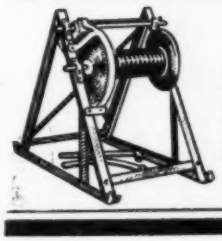

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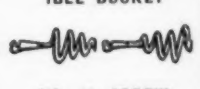

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Thirteen chapters cover all public health phases of the subject, including distribution, behavior and sanitary significance of bacteria in water. The chapters cover bacteria in natural waters; collections of samples; determination of organisms at room temperatures; interpretations of bacterial counts; determination of organisms at body temperature; coliform organisms; the presumptive test, confirmation and differentiation and significance; other index organisms; significance of bacteriological examination, bacteriology of sewage, and examination of shellfish. The appendix contains tables for determining the most probable number.

Fifty-three pages of bibliography testify to the thoroughness of the preparation of the book, and a fourteen page index likewise adds to its usability. The text contains 123 tables but only one illustration.

Inasmuch as Mr. McCrady was the Referee of the Bacteriological Methods which are to appear in Part IV of the 9th Edition of Standard Methods for the Examination of Water and Sewage, the material in "Water Bacteriology" are in complete agreement with those official methods.

It is unfortunate that the book was issued just prior to the adoption of the 1946 U. S. P. H. S. Drinking Water Standards. The 1942 Standards quoted are out of date insofar as those sections which were revised in the 1946 Standards. (In reference to the bacterial features of these standards, there was little change.)

Water Bacteriology is a book that should be in every water and sewage works laboratory. Containing 368 pages, the book is published by John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y., and retails for $4.50. (G. E. S.)

Patent Background for Engineers

"Since . . . 1936 the Allis Chalmers *Electrical Review* has frequently published articles on patents designed to be of interest to the practicing engineer. So favorably were these articles received, that it was decided to reprint them. . . ." So says the footnote written by J. J. Kane, General Patent Attorney, Allis-Chalmers Co., on the Table of Contents page in a book titled **"Patent Background for Engineers."** This 56 page book contains 15 articles written by patent attorneys of the company. Quotations of topical sentences from the various articles will serve to indicate the broad scope and valuable information in these articles.

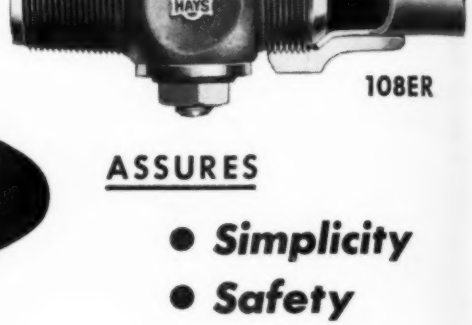
Patent Quicksands. "Just as a person in ill health consults his doctor, so should an engineer anticipating patent troubles consult his patent attorney. But a knowledge of basic patent fundamentals allows an engineer to avoid such troubles or to help his attorney solve them."

Know Your Patents. "The relative importance of the drawing, the specification, and the claims in the evaluation of a patent."

Patent Fallacies. "Without attempting to 'debunk' the American patent system, certain long-time fallacies must be exploded. 'Building a better mousetrap' does not necessarily mean the world will beat a path to your door."

Protecting New Inventions. "Shrouding an invention in secrecy is likely to defeat its own ends. Instructions for inventors should read, 'Write it down; get it witnessed, reduce it to practice!' "

HAYS



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Inventions for Sale. "By observing a few simple rules, an inventor—lacking the means to promote his invention himself—can do much to safeguard his rights and encourage its success."

Who Invented It. "Because failure to file a patent under the name of the *real* inventor makes it invalid, the importance of determining 'who invented it' cannot be overstressed."

Joint Inventorship. "If more than one person contributes to an invention, the invention becomes a joint one. And reluctance to give credit where credit is due can lead to invalidity."

Patent Interference. "'Interference' as used in patent law does not pave the way for touchdowns. Rather it has proved a headache to many inventors whose priority is contested by rival claimants."

Can You Keep a Secret? "What to do—keep your newly invented process a secret or expose it to competition by getting a patent?"

Public Use in Private, or Vice Versa. "To be valid, a patent application must be filed within one year from the first 'public use' of an invention. But 'experimental use' is encouraged. Question: When is a public use, when experimental?"

Inventions "On Sale." "Invented articles may be sold before filing application for patent without detracting from resulting United States patent rights. When is an article 'on sale' and how long it may be on sale before filing an application for a patent covering it?"

Trend of Development in American Patent Law. "Shifting social and economic concepts are reflected in changed interpretations of patent law. And the age old battle of human rights versus property rights is waged in this field continually."

What Would Compulsory Patent Licensing Mean to You? "Congress considers legislation that might be interpreted as a limitation of free enterprise. Here are some salient facts on what compulsory patent licensing would mean to the inventor . . . to business . . . to the public."

Streamlining Patent Prosecution. "Tear-drop automobiles, streamlined locomotives, sleek stratoliners . . . all are functionally designed for greater speeds. To expedite granting of patents, Congress passes legislation that streamlines patent prosecution to this fast-moving era."

Concerning Trade Marks. "The value of a trade mark lies in the good will associated with it. Incorrect usage of a trade mark may result in the loss of valuable rights."

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CHECK VALVE

with Built-in Mercoid Motor Shut-off Switch for Automatic Pump Protection

PROTECTS PUMP FROM DAMAGE DUE TO LOSS OF WATER

PREVENTS OPERATION OF PUMP UNTIL PROPERLY PRIMED

Flow switch insures pump against damage in event pump loses water during operation. Mercoid switch is actuated by valve-flap. Switch is connected into no-voltage coil of motor starter.

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Serving the Nations' Health and Comfort

SALES OFFICES IN PRINCIPAL CITIES

For engineers, chemists, or other technical personnel interested in the matter of patents, their granting, their value, and related subjects, this series of articles printed in the book, "Patent Background for Engineers," is worth writing for to the Allis-Chalmers Co., Milwaukee, Wis.

Anderson (Ind.) Booklet on Sewage Treatment

Outstanding Example of Good Public Relations Practice

One of the best ways in which a sewage works can establish and maintain good public relations with the townspeople is to inform them truthfully, yet in an interesting manner, of the aims and accomplishments of the plant.

R. R. Baxter, Supt. of Sewage Treatment at Anderson, Ind., has done an outstanding job in this direction through the medium of a small booklet prepared on the Moss Island Treatment Works of that city.

In simple language with relatively few words, and a picture on each page, Mr. Baxter not only tells the story of why sewage treatment is necessary, but also tells how it is accomplished at the Anderson plant.

Beginning with the purification of the water supply, Mr. Baxter takes the reader through the various phases of the sewage treatment plant operation. The illustrations are an integral part of the story.

Persons interested in an excellent example of the art of informing the public should write Mr. Baxter for a copy of his brochure on the Anderson, Ind. plant.

Glauber AGAIN OFFERS YOU A COMPLETE LINE OF COPPER PIPE GROUND KEY STOPS AND FITTINGS

Red Brass inverted key curb stops with round way for copper service pipe both ends. Other ground key work, fittings and lead goosenecks for your waterworks requirements.

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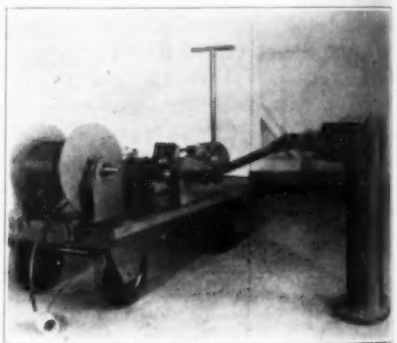
GROUND-KEY CURB and CORPORATION STOPS
LEAD GOOSENECKS and WATERWORKS FITTINGS

MANUFACTURERS' and EQUIPMENT NEWS

New Dean Power Truck

Payne Dean & Co. of Madison, Conn., has developed the Dean Electric Power Truck for power operation of floor stand operated sluice gates and underground gate valves around pumping stations, filtration plant floors, and dams. The new power truck shown in the accompanying photograph has two horizontal slow speed shafts either of which may be connected to the floor stand shaft by a telescopic



or flexible shaft. It also has a vertical slow speed sliding shaft with universal joint in the head, for operating gates beneath the ground. Power is furnished by a polyphase motor unit which drives through a chain of bevel gears. All shafts are connected to two Veeder Root counters showing the actual number of turns made. A reversing switch, take up cable drum, and connecting plug are furnished as

part of the equipment. Horizontal and vertical drive shafts form part of the unit.

The truck may be locked in position by brakes and will not turn under heavy loads. The platform is 30 by 48 inches, and the truck has a sufficient capacity to operate gates from 12 to 60 inches.

A bulletin on the new Dean electrically operated power truck may be obtained by writing Payne Dean & Co., Madison, Conn.

Komline-Sanderson New Corporation in Field

Thomas R. Komline and Walter H. Sanderson have announced the formation of the Komline-Sanderson Engineering Corp. for the purpose of developing and marketing machinery and equipment for the treatment of sewage and industrial wastes. In particular the new corporation will market a sludge drier and furnace to be known as the Komline-Sanderson Sludge Drier and Furnace.

This drier and furnace is the result of the combined work of John R. Downes and Mr. Komline at the Plainfield, N. J., plant, where one of these sludge drier furnaces has been in operation for eight years.

T. R. Komline

W. H. Sanderson

Arrangements have been made with the Instant Drying Corporation for the use of the basic patent on the spray-drying of sewage sludge in connection with the operation of this equipment. The company has also been licensed to work with the Wright Cord Filter and will incorporate in their operations the materials handling equipment manufactured by the Gifford-Wood Company of Hudson, N. Y. This latter company builds a complete line of equipment for the conveying and handling of grit, sludge, ash, chemicals and other materials.

Both Messrs. Komline and Sanderson have recently returned from service in the U. S. Army, the for-

The *Coagulant* that *Cuts Costs!*

TENNESSEE CORPORATION Ferri-Floc

Ferri-floc . . . the ferric coagulant that is successfully and economically used in sewage treatment throughout the United States. Take advantage of modern plant research and findings: use Ferri-floc. Tennessee Corporation's technical staff will be glad to help you with your specific problems. Write to us today. The consultation service is free, of course.

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A Filter Medium For All Purposes

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FOR SEWAGE AND WASTE TREATMENT

The Impingement Aerator

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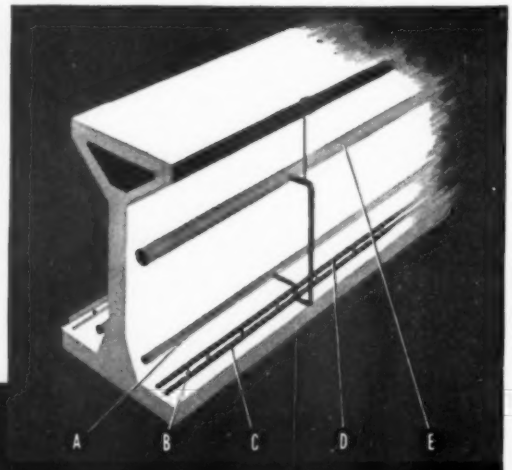
Far superior to the diffuser tube and plate systems, this advanced design offered by PROQUIP provides opposing water and air jet streams discharging against a double cone. Result — an impingement contact producing ideal aeration.



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Engineering Offices and Laboratories • Aurora, Illinois

Northrop Water Works Test Set

Northrop & Co., Inc., 50 Church St., now have on the market a complete Test Set for Hydrant Flows, Pressure and Loss of Head. The complete set shown in the accompanying cut contains the following elements: Hand Pitot with Air-Chamber and

Throttling Cock; Combination Hand Clamp Pitot with Air-Chamber and Throttling Cock; Two-scale Gage for 2½-in. hydrant openings, lb. pressure and gal. per min.; Hydrant Cap Gage, 100 or 160 lb.; Faucet Gage, 100 or 160 lb.; Hydrant Cap Adaptor, and Carrying Case. Complete information and instructions for use may be obtained from Northrop & Co., Inc., 50 Church St., New York 7, N. Y.

G. B. Coffey Manages A. M. Byers' Chicago Division

A. M. Byers Company has announced the appointment of George B. Coffey as manager of the firm's Chicago division with offices in the Conway Building. Mr. Coffey succeeds W. A. Taylor, who has resigned to enter private business.

G. B. Coffey

A native of Indiana and a graduate of the University of Indiana, Mr. Coffey has been with Byers Company since 1930.

mer having served in the Sanitary Corps and the latter in the Airborne Engineers. For eight years prior to the war Mr. Komline was engaged in the development of the sludge drier and other equipment at the sewage disposal plant at Plainfield, N. J., with Mr. Downes. Mr. Sanderson has been active in the heavy construction field for 15 years.

The Komline-Sanderson Engineering Corporation has its offices in Ridgewood, N. J., and may be reached at Box 444, Ridgewood, N. J.

Liquid Conditioning Elects Officers

The Liquid Conditioning Corp., recently formed organization for the manufacture and sale of water conditioning processes for industrial, municipal, railroad, and household use, has announced the election of the following officers: S. B. Applebaum, President; H. L. Tiger, Vice Pres. and Treasurer; Norman L. Brice, Secretary and Chief Engineer; S. S. Sulzycki, Assistant Secretary and Controller. The company is located at 423 West 126th St., New York City.

"Dan" Atwill Joins Dresser as New England Manager

Daniel J. Atwill has joined the Dresser Manufacturing Division as New England District Manager for the sale of Dresser products to the water industry. Mr. Atwill will make his office in New York and will work in conjunction with Ross Scott, Dresser's Water Works Consulting Engineer. Mr. Atwill will be responsible for the sale of Dresser couplings, fittings and repair products in New Jersey and all of the New England States. Under this arrangement, Mr. Scott will be able to devote his interest to special water works problems all over the country.

"Dan" Atwill

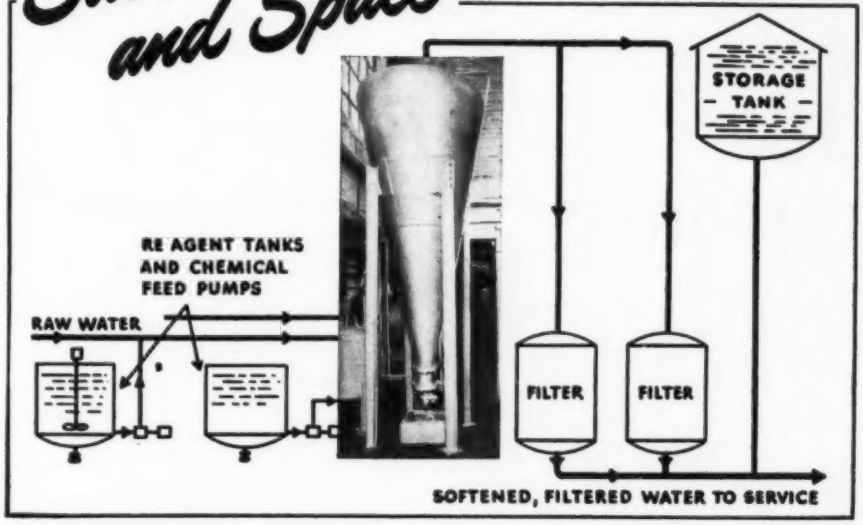
Before joining Dresser Manuf. Div. Mr. Atwill was associated with the A. D. Smith Co. and earlier represented the Pittsburgh Equitable Meter Co. in New England.

Foxboro Announces Model 40 Controller

The Foxboro Co. of Foxboro, Mass., has announced the Model 40 controller as an improvement over the Model 30 issued in 1942. Model 40 is recommended for control of temperature, pressure, flow and other variables in continuous processes, and its main features may be generalized as a simplification of design,

NEW SLUDGELESS WATER SOFTENER...

Saves time and Space



Permutit* Spiractor applies established principles in a new way

Permutit's Spiractor—latest addition to modern cold lime or lime soda water treatment—operates on the principle of intimate contact with solid nuclei for accelerated precipitation. The conical container—itself a great saving in space over other type systems—is more than half filled with fine granules of calcium carbonate catalyst. Hard water and lime soda precipitant enter at bottom, mix at once, flow upward through catalyst bed. This tangential inflow gives a rising swirling motion that greatly speeds softening reaction by affording immediate contact between chemically treated water and suspended granules.

Precipitated hardness deposits on the surface of these granules which increase in size. There is no watery sludge; the enlarged granules are readily disposed of like moist sand grains. Detention period of the Spiractor is only five to ten minutes.

For more information write The Permutit Company, Dept. W9, 330 West 42nd St. New York 18, N. Y., or Permutit Co. of Canada, Ltd., Montreal.

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WATER CONDITIONING HEADQUARTERS

REPAIR and SAVE

Water Meter Measuring Chambers

with the

MEMPHIS SLOT INSERT

of stainless steel with new bronze thrust roller.

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ZECO and HI-ZECO Greensand Zeolite for water softening, filtration and iron removal. ZECO Manganese Zeolite for iron and manganese removal. COREXITE mineral for corrosion control and water stabilization.

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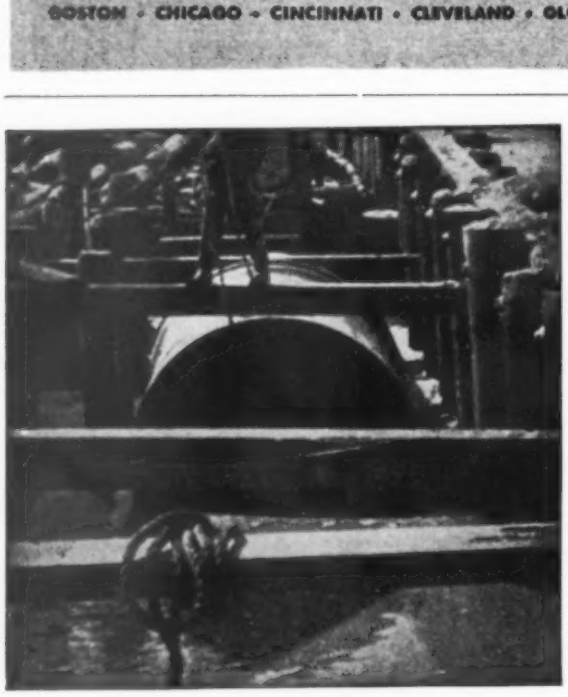

84" pipe—Spring Lake, N. J.

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FLEXIBLE JOINT PIPE
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Large stock enables us to make prompt shipments.

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SIZES 2" TO 84"

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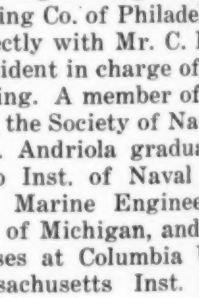
sturdy unit construction, easier and more flexible adjustment, and new convenience in servicing.

One outstanding characteristic of the Model 40 is its adaptability in changing from one type of control to another. Setting of the proportional band, from 0 to 200 per cent or higher, is easily made by the turn of a thumb wheel. The Model 40 is an indicator as well as a single-pen and multi-pen recorder and is available for on-off control action, proportional, proportional and reset, proportional with derivative, and proportional and reset with derivative types.

All types of this instrument are described in Bulletin 381, which may be obtained from the Foxboro Co., Foxboro, Mass.

A. D. Andriola to Head De Laval Engineering Research

To head its recently announced engineering research program, the De Laval Steam Turbine Co. of Trenton, N. J., announced today the appointment of A. D. Andriola as Chief Research Engineer.



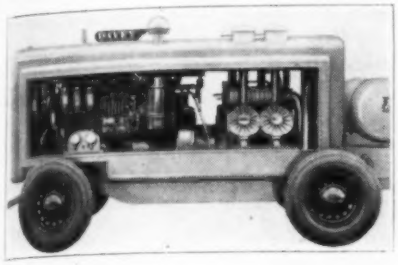
A. D. Andriola

Mr. Andriola, who since 1941 was assistant to the Vice President in charge of engineering of the Cramp Shipbuilding Co. of Philadelphia, will work directly with Mr. C. R. Waller, Vice President in charge of De Laval Engineering. A member of the A. S. M. E. and the Society of Naval Architects, Mr. Andriola graduated from the Webb Inst. of Naval Architecture and Marine Engineering and the Univ. of Michigan, and took special courses at Columbia Univ. and the Massachusetts Inst. of Technology.

The new engineering research program which Mr. Andriola heads will be chiefly devoted to the development of improved turbines, compressors, pumps and marine and aircraft units.

1947 Model Davey Air Compressor

Davey Compressor Co. of Kent, Ohio, has announced the production of the first model of the 1947 Davey line, known as the 315-W (gas) and the 315-WD (diesel), an air compressor to produce 315 cubic feet of free air per minute at 100 psi. The compressor shown in the accompanying photograph is available in standard skid, steel wheel trailer, and pneumatic-tired trailer mounting



style, as well as flanged wheel types for railroad work. The compressor unit itself is a new departure in design, consisting of two banks of three cylinders, each bank being arranged in a W form. This construction, with a short 4-in. piston stroke, reduces compressor vibration to a minimum, and permits a substantial reduction in dimensions and weight.

Further information on the Davey Portable Compressor Model 315-W and 315-WD may be obtained from the Davey Compressor Company, Kent, O.

Kalinske Infilco's Chief Hydraulic Engineer

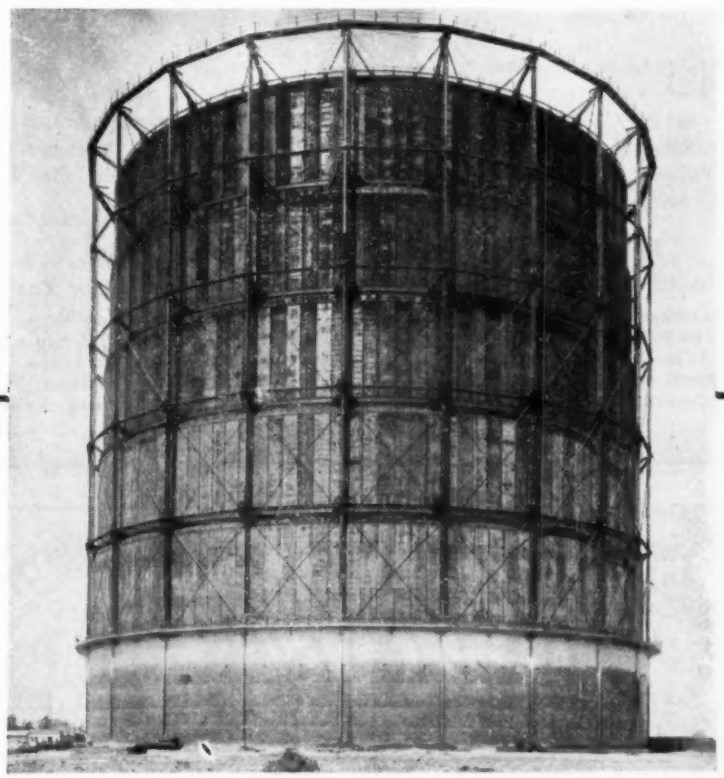
Announcement has been made by Infilco, Inc., of the appointment of A. A. Kalinske to the post of Chief

Hydraulic Engineer. A native of Plymouth, Wis., Kalinske attended the University of Wisconsin, where he received his M.S. in Sanitary Engineering in 1935. Since that time Mr. Kalinske has been Associate Professor at the University of Iowa, and Associate Director of the Institute of Hydraulic Research at that institution. During the war he did special consulting work for the U. S. Navy on fluid mechanics problems. An author of some fifty papers, Mr. Kalinske is a member of the American Standards Association Committee and has been largely responsible for many of the provisions of the National Plumbing Code now being completed by that group.

E. A. Walker Joins Clay Sewer Pipe Assn. Field Staff

The Clay Sewer Pipe Association, Inc., has announced the addition to its technical staff of Edward A. Walker, effective August 1, 1946.

Mr. Walker has been connected with the Pennsylvania Department of Health since 1937, and prior to that time was with the Pennsylvania Railroad Co. and John F. Casey Co., Pittsburgh, Penna.



AT LONG BEACH...LARGEST OF ITS TYPE

A Stacey Brothers Installation

Here's a 5,000,000 cu. ft. Wet Seal Holder—*the largest All-Welded Panel Type installation in the United States!*

This is the third Stacey Brothers holder for the City of Long Beach—another important endorsement of the famous Stacey Brothers patented design.

All-Welded Panel construction saves on original investment, on erection time—*and on maintenance expense.*

You may never need capacity as large as this Long Beach installation—but our experience in the design, fabrication and erection of wet seal holders covers every size from 100 cu. ft. up. This experience can be valuable to you when you want long life and dependable holder operation. May we talk over your requirements with you?

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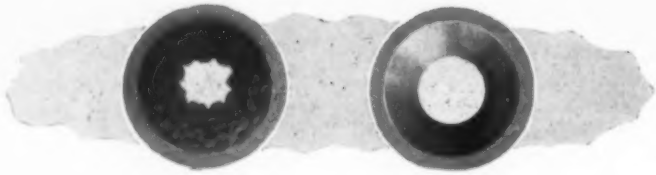
Stacey Brothers
ALL-WELDED GAS HOLDERS



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From Washington, D. C., to the Pacific, North, South, East and West, National Water Main Cleaning experts stand ready to serve you —guaranteeing to restore your mains to 95% of original capacity.

For as many as 40 years—longer than most water works men have been engaged in their professional work, National Water Main Cleaning Company has been building up an organization of engineers trained in the art of rehabilitating water lines.

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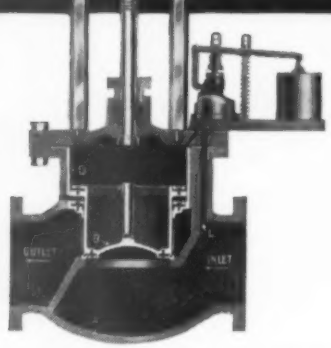
GOLDEN-ANDERSON ELECTRIC and MANUAL WATER SERVICE VALVES



Suitable for any spray service requirement or for remote electrical control. Instant manual or automatic operation. For any high or low pressure water service valve need—get the facts from Golden-Anderson. Over 1500 standard types and sizes.

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WRITE FOR THIS BULLETIN

FOR

pH Control and WATER TESTS

A study of our 28-page Bulletin No. 602, containing the complete line of Hellige apparatus for pH control and water analysis, will enable you to form an intelligent opinion as to what is best suited for extending your present equipment or for an initial installation.

HELLIGE
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3718 NORTHERN BLVD. LONG ISLAND CITY 1, N.Y.
HEADQUARTERS FOR COLORIMETRIC APPARATUS

Mr. Walker, who is a Civil Engineering graduate of Pennsylvania State College, is to be District Engineer in the State of Pennsylvania and will be located at 503 Chestnut Street, Greensburg, Pa.

New Rotameter Tube

Fischer and Porter Co. have announced a revolutionary Bead-Guide Rotameter metering tube. This new tube eliminates the need for float guide rods, inasmuch as the guiding of any shaped float is done by three ribs formed in the inner surface of the tapered corrosion resistant glass metering tube.

This new tube has several advantages for use with corrosive as well as viscous liquids. Further information about this new tube which can be used to replace old style tubes may be obtained from Fischer and Porter Co., Dept. 9F-6, Hatboro, Pa.

R. R. Newquist Vice Pres. Roots-Connersville

Ralph R. Newquist has been elected Vice President in Charge of Sales of Roots-Connersville Blower Corp., Connersville, Ind., one of the Dresser Industries.

Mr. Newquist is a native of Youngwood, Pa., and a graduate of Pennsylvania State College. He has previously been employed by the Reliance Electric & Engineering Co., The Louis Allis Co., and the Allis-Chalmers Mfg. Co.

Broxham Manages Graver's Fabricated Plate Div.

Willard M. Broxham has been named manager of sales for the fabricated plate division of the Graver Tank and Manufacturing Co., Inc. Mr. Broxham was formerly manager of the concern's Philadelphia office. His headquarters will now be at the general offices of the company in East Chicago, Ind.

D. E. Fricker Returns to Le Roi

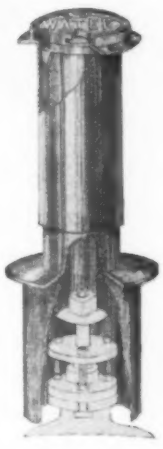
Le Roi Co. of Milwaukee, manufacturers of gasoline engines, air compressors, and engine-generator sets, has announced the return of D. E. Fricker. Mr. Fricker will serve as assistant to the advertising manager to handle sales promotion work and trade shows.

D. E. Fricker

Prior to his entry in the army where he served for two and a half years, most of which was in Italy, Mr. Fricker was in advertising work for the Le Roi Co.

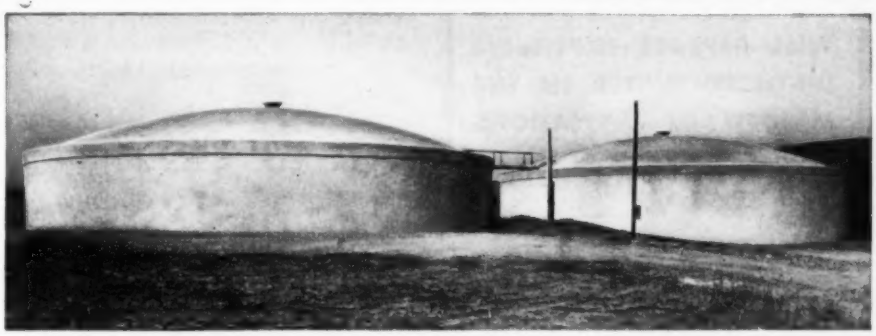
"Duro" Valve Boxes

The Lee Hydraulic Co. of Troy, N. Y., has introduced the "Duro" Two Piece Sliding Adjustable Valve Box. These valve boxes are fabricated from steel plate and are well protected with a heavy, plasticized, corrosion resistant coating. Parts are interchangeable with many standard cast iron boxes. The cover is cast iron, non-tip and easily removed.



The accompanying cut shows a typical box installed over a gate valve. The boxes may be obtained for valves up to 12 inches and for trench depths up to 8 ft. Further information may be obtained from the Lee Hydraulic Co., P. O. Box 804, Troy, N. Y.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.



PRE-STRESSED "GUNITE" TANKS

Above are shown two 80' diameter 750,000 gallon prestressed "GUNITE" water storage tanks with "GUNITE" dome roofs. We built these tanks in 1943 for the Borough of Schuylkill Haven, Penna.

Prestressed "GUNITE" produces a water storage tank which is bottle tight and maintenance free. They may be built either at ground level, completely underground with earth covering over the dome roof, or may be in the form of stand-pipes or elevated tanks.

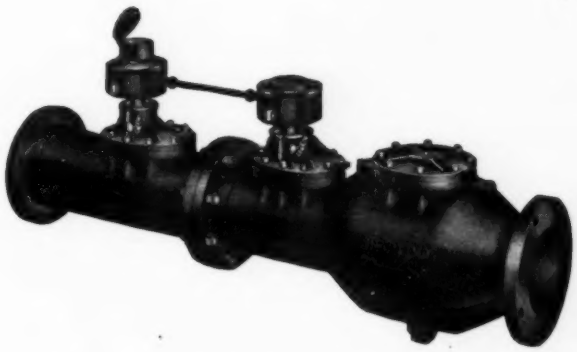
Our experience in this field includes scores of tanks and silos of many types ranging up to two and one-half million gallons capacity.

Our 72 page Bulletin C2300 describes this method of construction fully and also other uses of "GUNITE."

Write for your free copy of Bulletin C2300 today.

MANUFACTURERS OF THE "CEMENT GUN"

SPARLING MAIN-LINE METERS



COMPOUND METERS
for Mains 6-inch to 36-inch

Consistent accuracy is assured over a range of flows as wide as 1 to 125, with head loss the lowest of any compound meter. One totalizer registers from both meter units.

Bulletin 309 comes upon request

SPARLING

Manufacturer of Water Measuring Equipment

LOS ANGELES 54...Box 3277 Terminal Annex — 6822 Broadway.....CINCINNATI 2
CHICAGO 16.....3104 South Michigan Ave. — 101 Park Avenue.....NEW YORK 17
BOSTON 8.....6 Beacon Street

LOW COST DEMINERALIZED WATER

WILL REPLACE EXPENSIVE DISTILLED WATER IN THE MAJORITY OF APPLICATIONS

★ Demineralized Water suitable for many requirements demanding distilled water, can now be obtained at a fractional part of the cost of distillation. Belco deliveries are surprisingly rapid.

MODERNIZE YOUR ZEOLITE WATER SOFTENERS

The new Belco zeolite will increase the capacity of industrial softeners up to six times as much. Ideally suited for modernization of present equipment. Belco engineers are always available to help you.

BELCO INDUSTRIAL EQUIPMENT DIVISION

50 IOWA AVENUE
PATERSON 3,
NEW JERSEY

CHECK WITH BELCO...first!

Belco

INDUSTRIAL PROCESSING EQUIPMENT SINCE 1892

Sheffield Heads National Clay Pipe Manufacturers

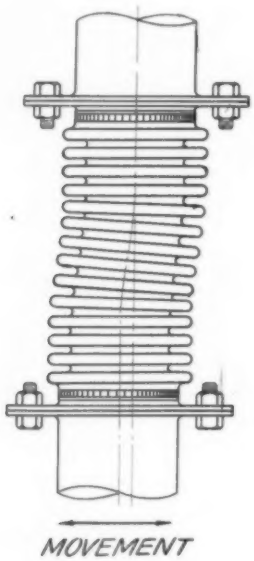
At a meeting of the National Clay Pipe Manufacturers, Inc., Eugene K. Sheffield, President and General Manager of the Logan Clay Products Company of Logan, Ohio, was elected President of the

NCPMI. Mr. Sheffield succeeds Edward F. Clemens, vice-president of the Cannelton Sewer Pipe Co., of Cannelton, Ind., who resigned the position due to the press of other business.

Other officers of the NCPMI are D. M. Strickland of Atlanta, vice-president; J. D. Cook of Chicago, secretary-treasurer; and Fred S. Cresswell of Washington, D. C., manager.

CMH Stainless Steel Bellows

Although the use of stainless steel bellows is more or less new to the water and sewage works field, these bellows shown here have found wide



application as equalizers, compensators, expansion joints, flexible connectors, for flow control, vapor and steam traps, thermostatic instruments, and electrical controls.

STEEL FORMS for CONCRETE METER BOX TILES

You can make excellent meter box barrels at low cost with one of these steel forms. They are made in several sizes and lengths.

Let your post-war plans include making good use of one or more of these forms. Make a start now by asking for information.

FORD Meter Box Co.
WABASH, INDIANA

RODNEY HUNT'S

"POWER-SAVER"

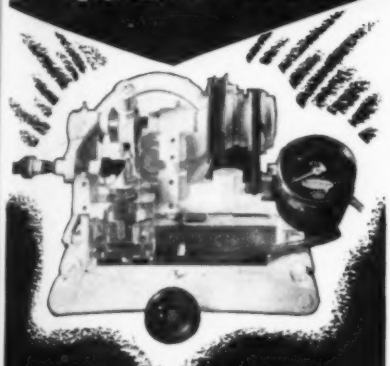
TRASH RACKS and RAKES

The latest and best in water controlling apparatus. 1. The improved Rodney Hunt POWER-SAVER Trash Rack, with welded Back Bar Construction. Strong, **easy to clean**, quick to install, protected against corrosion. 2. Rodney Hunt's POWER-SAVER Buoyant Trash Rakes, with non-corrosive stainless steel heads, and the new "Feather-lite" tubular handle. Almost effortless operation. For the complete story—

Write today for Bulletins Nos. WCA-146 and WCA-147

RODNEY HUNT MACHINE COMPANY
118 Lake St. Orange, Mass., U. S. A.

IT'S THE *Combination* THAT COUNTS!



Only Var-I-Feeder combines 1 — Tachometer count, 2 — variable speed drive, 3 — high injection rate.

Any chemical feed pump can be stepped up to high speed, though on most feeders revision of check valves or other changes are necessary to feed at hundreds of strokes per minute.

Any chemical feeder can be improved by augmenting stroke length adjustment by a variable speed drive or variable pitch pulleys.

Any chemical pump can have an indicating Tachometer added for continuous observation of speed.

But only Var-I-Feeder offers this combination, in which feed is controlled by speed, and measured by the indicating Tachometer. Speed changes on Var-I-Feeder are achieved easily and quickly without stopping the process, by a turn of the fingertip control wheel. Turn the wheel and watch the tachometer. Measured speed measures feed.

VAR-I-FEEDER *is the chemical feeder that counts.*

Send for free bulletins VARI and Add-A-Feeder 91.

VAR-I-FEEDER

FOR ACCURATE CHEMICAL FEEDING
CHEMICAL WATER TREATMENT
CHLORINE DIOXIDE PROCESS
FOR TASTE AND ODOR CONTROL

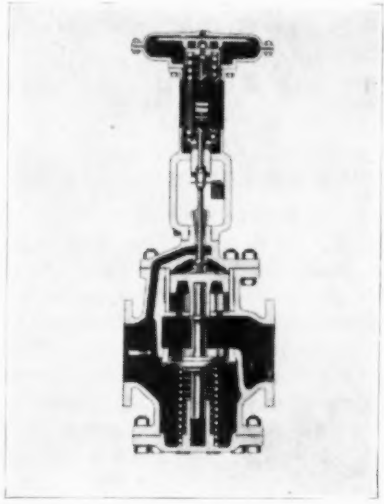
CHEMICAL FEEDERS DIVISION
MORSE BOULGER DESTRUCTOR CO.
NEW YORK 17, N. Y.
Room 1700 B 205 E. 42nd Street

Representatives in all principal cities
Equipment Makers and Proportioning Engineers

Further information on the use of these bellows may be obtained from the Chicago Metal Hose Corp., Maywood, Ill.

Diaphragm Regulating Valves

Leslie Company of Lyndhurst, N. J., has announced a new line of single-seated, fully balanced diaphragm regulating valves for process industries and power plants. These valves are made with cast iron, bronze, and steel bodies for steam,

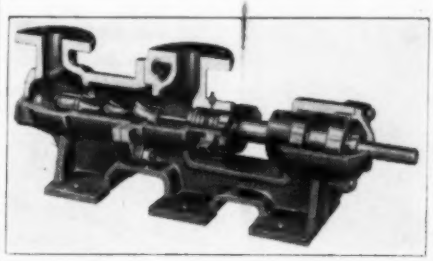


air, or gas pressures up to 1000 psi. They are designed to be actuated by standard pressure or temperature instruments or controllers using 20 psi. air or clean water.

Further information on this new diaphragm regulating valve may be obtained from the Leslie Co., 191 Delafield Ave., Lyndhurst, N. J.

The Moyno Tubular Pump

The Robbins and Myers MOYNO pump has been manufactured in this country since 1936 but it is much older in Europe. Its use in water and



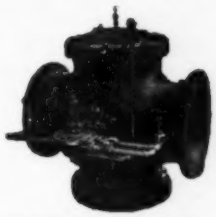
sewage plants in this country is almost unheard of—almost, but not quite, for one of these unique pumps is used to pump sewage samples at the Buffalo, N. Y., plant.

With only one moving part, this pump is not even similar to any other

· 1879 ·
ROSS
AUTOMATIC VALVES

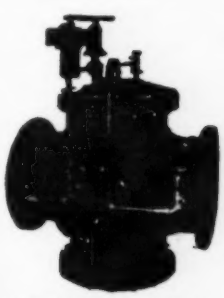
ALTITUDE VALVES • SURGE • RELIEF • BACK PRESSURE VALVES

FLOAT VALVES • REDUCING AND REGULATING VALVES



ALTITUDE VALVES
for
Control of elevation and heads into and out of tanks, basins and reservoirs, hydraulic control.
1. Single acting.
2. Double acting.
3. Combination assembly for three or more automatic operations.
4. Can be equipped with electric and manual controls.

COMBINATION VALVE
This valve will permit flow in one or both directions acting as
1. Pressure Reducing and Relief Valve.
2. Pressure Reducing and Altitude Valve.
3. Relief and Altitude Valve.



REMOTE CONTROL VALVE
Electric remote control—solenoid or motor can be furnished.
Adapted for use as primary or secondary control on any of the hydraulically controlled or operated valves.

ROSS VALVE MFG. CO.
INCORPORATED
P. O. BOX 595, TROY, N. Y.

pump and yet it combines advantages of all other types. As can be seen from the accompanying cut, the pump consists of a rotor revolving within a stator. Both are helically shaped.

While the action is difficult to describe without diagrams, the pump itself has remarkable characteristics; it has no valves, no pulsation, easy maintenance, wide pressure variation, is self priming, and will pump anything that will flow within a pipe. These pumps appear to have many other applications beside pumping sewage samples. They can, for example, be used for pumping coagulating chemicals, activated carbon, sewage sludge, lime slurries, grease, etc.

Further information on these new type pumps may be obtained from the Robbins and Myers Co., Inc., Springfield, Ohio.

American Well Works Buys Foundry

American Well Works of Aurora, Ill., has announced the purchase of the Atlas Foundry, located in Chicago. No change in management of organization will be made, but the plant will operate as a wholly-owned division of the American Well Works.

LITERATURE AND CATALOGS

Slurry Pump

Morris Machine Works of Baldwinsville, N. Y., has issued a 2-page folder on the new **Morris Type R Slurry Pump.** This is the pump which requires the removal of only four bolts for dismantling and which has many advantages for the pumping of slurrys, sludges, etc.

The bulletin may be obtained by writing the Morris Machine Works, Baldwinsville, N. Y.

Centrifugal Pumps

In an 8-page bulletin, Economy Pumps, Inc., of Hamilton, Ohio has desscribed a **Type SCV Pump.** This is a centrifugal pump with horizontal side inlet and outlet and motor mounted above. The SCV unit is medium priced, compact and precision built. The motors are high and are not exposed to dust, dirt, or water from the blower; pump rotor is easily accessible, and the pumps are designed for perfect rotor alignment.

Among the many services for this SCV pump, there are cold water circulation, pressure boosting, hot water circulation, air conditioning systems, boiler feeding, washing machinery, sprinkler systems, etc.

Write to Economy Pumps, Inc., Hamilton, Ohio, for Catalog No. E-246.

Feedwater Treatment, Rust Prevention

To the best of our recollection, this is the first copy of the *Dearborn News* we've seen. Published periodically by the Dearborn Chemical Co. this number contains some interesting information about some old friends and acquaintances of many years. For instance there is a short story about the return of Dr. Wayne Denman, as Chief Chemist, after four years' service as a major in Chemical Warfare Service. There is also a short article by E. P. Fager on Scientific Application of Feed Water Chemicals; and of course, there is a story of No-Ox-Id with

STOP THAT RAIN
from coming into my basement through the sewer!

When backwater from sewers backs up into basements of homes in your community, will you be called upon to handle the complaints? It is your duty to be able to furnish correct information on how to prevent this costly and unsanitary hazard! The Josam Side-Swing Sewer Valve is the product designed to do this job for the home permanently and efficiently. Waterworks and sewage officials and maintenance men should have complete information on this product. The literature illustrated gives you a full understanding of the troublesome backwater problem and how to solve it properly.

JOSAM MANUFACTURING CO.
320 Empire Bldg. • Cleveland 14, Ohio
Representatives in all Principal Cities
JOSAM-PACIFIC CO., San Francisco, California
West Coast Distributors
EMPIRE BRASS CO., LTD., London, Ontario, Can.
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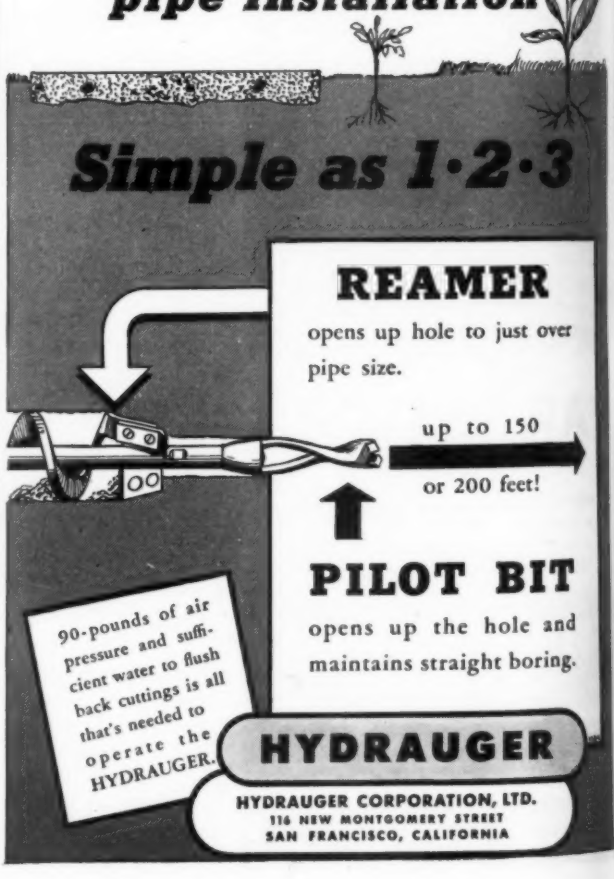
Send for FREE literature today!

JOSAM MFG. CO., 320 Empire Bldg., Cleveland 14, Ohio
Send free literature on "How To Control Backwater"

NAME.....
TITLE.....
ADDRESS.....
CITY & STATE.....

UNDERGROUND
pipe installation



Simple as 1·2·3

REAMER
opens up hole to just over pipe size.

up to 150 or 200 feet!

PILOT BIT
opens up the hole and maintains straight boring.

90-pounds of air pressure and sufficient water to flush back cuttings is all that's needed to operate the HYDRAUGER.

HYDRAUGER
HYDRAUGER CORPORATION, LTD.
116 NEW MONTGOMERY STREET
SAN FRANCISCO, CALIFORNIA

which we are very familiar as an anti-rust protective coating that has proved so successful in water and sewage works.

Another interesting item is the history of the formation of the Dearborn Chemical Co. which started when William H. Edgar saw a boiler removed from a building because it was so badly incrusted. He suggested that the deposit instead of the boiler be removed, and then cooked up the first batch of Dearborn Chemical Boiler Treatment on a kitchen stove.

The Dearborn News may be obtained from the Dearborn Chemical Co., 310 So. Michigan Ave., Chicago 4, Ill.

Tachometers

If you wish to record, or indicate, speed of rotation and speed of travel, what you need perhaps is a **Bristol Tachometer** described in Bull. S1400 of the Bristol Co. This twelve-page bulletin includes a complete description of the Pyromaster potentiometer-type tachometer, together with a description of the millivoltmeter-type indicating and strip-chart recording tachometers. Complete wiring diagrams, application data, etc., including illustrations are shown in the bulletin. Copies of the bulletin are available from The Bristol Co., Sales Promotion Dept., Waterbury 91, Conn.

Time Control

Bulletin T-55 titled **Special-Built Time Switches for the Volume User** has just been released by the Automatic Temperature Control Co., Inc. Shown in this 4-page folder are six examples of time switches for special uses. These include adjustable on and off periods, fixed time delay before restarting, adjustable-plus fixed time delay, reversing motor, and interval timing.

A copy of this Bulletin T-55 may be obtained from the Automatic Temperature Control Co., Inc., 34 East Logan St., Philadelphia 44, Pa.

D-C Commutation

Westinghouse Electric Co. has prepared a slide film, with running commentary, on commutation and commutator maintenance for D-C machines. The sound motion picture is known as **Commutation of D-C Machines**. The first half of it covers the theory of commutation, and the second half covers maintenance. In Part II on the "Maintenance of Good Commutation" the hazards against which one should guard are grease, moisture, looseness, worn brush-holder boxes, grooving, poor seating of brushes, and irregular inspection.

The bulletin is not for distribution, but the motion picture may be obtained for showing by writing the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

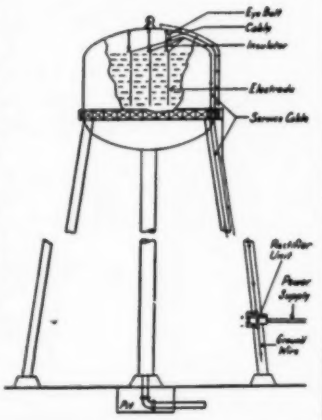
a.c.f.'s War Record

"To the workers, Men and Women, of American Car and Foundry Co. on both the industrial and combat firing lines this record is dedicated with deep appreciation." So reads the title page of **The Armed Forces of a.c.f.,** a hundred page book of pictures and text showing the materials that the American Car and Foundry Co. produced during the war; tanks, armor plate, shells, valves, tractors, bulldozers, bombs, and many other items as large and as important.

"This is not merely the story of a single company. In its larger as-

Permanent
PROTECTION
against under-water **RUST**

The Electro Rust-Proofing Cathodic System simply stops the electrolytic action which causes rust on submerged metal. It therefore stops rusting—instantly, permanently, economically. Kills the greatest cause of deterioration. Eliminates forever the costliest item of maintenance—draining, scraping, painting. Usually installed for about the cost of one paint job; operates year in and year out for a small fraction of ordinary painting cost. Used by thousands of municipalities and industries in water tanks, standpipes, flocculators, deep wells, and other water-handling equipment. Engineered to each installation. Advocated by independent authorities. Write for details, proof of performance, list of users.



ELECTRO RUST-PROOFING *Corporation*
DAYTON 10, OHIO, U. S. A.

3 *Money, Time and Labor Saving Features of*

UNIVERSAL
CAST IRON PIPE

Laid with Only Wrenches →
No Caulking Materials →
No Gaskets. No Bell Holes to Dig. →

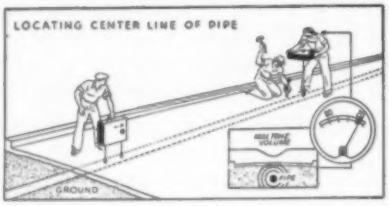
For water supply, fire protection systems sewage disposal systems, industrial, and irrigation. Flexible.

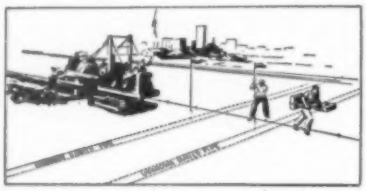
Dept. C.
THE CENTRAL FOUNDRY COMPANY
386 FOURTH AVENUE, NEW YORK 16, N. Y.

Gentlemen: Send us information and catalog on UNIVERSAL CAST IRON PIPE.

NAME .....
STREET .....
CITY .....

M-SCOPE





BURIED PIPE AND CABLE FINDER

16 PAGE BOOKLET FREE UPON REQUEST

FISHER RESEARCH LABORATORY

Palo Alto, California

How to join *more* bell and spigot cast iron water mains *per hour* ...*at less cost*

Haymanite
JOINTING COMPOUND

Haymanite creates substantial savings in time and materials . . . not only during installation, but while in actual service.

- Each lb. does the work of 4 lbs. of lead.
- No caulking.
- Large bell holes eliminated.
- Easily applied by ordinary workmen.
- No other materials used.
- Permanent.
- Withstands vibration without leaking.
- Self-sealing when broken.

Immediate deliveries from stock. Free, illustrated catalog on request.

***Producers also of* M. H. Brand Caulking Lead.**

MICHAEL HAYMAN & CO.,
INCORPORATED
ESTABLISHED 1869
870 EAST FERRY ST.
BUFFALO, N.Y.

pects it is a record intended to reveal to posterity what American industry, as exemplified by one of many companies can accomplish under a democratic form of government in an urgent hour of national need." This paragraph from the foreword explains why even those who may not have use for plug valves may find this an interesting booklet to keep as a memento of this past war. It may be obtained from the American Car and Foundry Co., New York, N. Y.

50th Anniversary—Lynchburg Foundry

In the Summer Issue of **The Iron Worker,** dedicated to the fiftieth anniversary of the Lynchburg Foundry Co., is a series of articles on the part that company has played in the last fifty years, its part in three wars and in peace. There are also articles on the early history of the company, its founding, its founder, its presidents, its officers, and its products. Pictures and stories of production, personnel, and products all go to make up this anniversary number.

The Iron Worker is published quarterly for free distribution by the Lynchburg Foundry Co., Lynchburg, Va.

Photocopying

We don't know how many of our readers have much occasion to reproduce records, maps, designs, letters, publications, etc., but there must be a few consulting engineers, professors, libraries, even large municipal engineering offices, that do often want copies made of various items. For you who do, we suggest you look into Apeco photocopy equipment, described in a bulletin titled **Streamline Your Copying with Photocopying.**

Write the American Photocopy Equipment Co., 2849 N. Clark St., Chicago 14, Ill., for this bulletin and further information on the process.

Multiple V-Belt Drive

The Multiple V-Belt Drive Assoc. of Chicago has issued a 16-page illustrated booklet entitled **How The Dominant Drive Speeds Production, Reduces Costs.** This book does not go into engineering details of the Multiple V-Belt Drive, but it does present the results of these

***for* CHLORINE *call on* JONES**

We are now in a position to supply chlorine, in unlimited quantities, for water works, sewage-disposal plants, and other municipal uses. Same high quality we produced to meet exacting Army and Navy specifications during World War II. Chlorine products, liquid, powder, and gas, packed in cylinders, drums, or carboys. Immediate delivery guaranteed in all sizes, from our plants at Indianapolis, Indiana, and Caledonia, New York. Write or wire for information.

JOHN WILEY JONES CO.
Chemical Specialties
124 HARDWOOD AVE.
CALEDONIA, N.Y.

FINE SCREENS
FOR
SEWAGE
AND
INDUSTRIAL WASTES
TREATMENT

FORMER CONCEPTIONS COMPLETELY OUTMODED

NO COSTLY, POWER CONSUMING REVOLVING BRUSH ARMS—25% GREATER SUBMERGED AREA.

NEW SCREEN PLATES FOR THE ECONOMICAL USE OF A FILTER MEDIA ON THE SCREEN, THUS INSURING GREATER REMOVALS THAN POSSIBLE HITHERTO.

COMPLETELY AUTOMATIC CONTROL POSITIVE SEAL RINGS.

MODERN DESIGN
HIGHEST EFFICIENCIES
LOWEST COST

SANEQUIPMENT ENGINEERING
2843 WHITEWOOD AVE.
ANN ARBOR, MICHIGAN

DESIGNERS — CONSULTANTS

Protects Sewage Works against Fire and Explosion Hazards

Send for Bulletin 121-A describing P.F.T. Flame Traps, Pressure Relief Flame Traps, Waste Gas Burners, Condensate Drip Traps, Pressure Gages and other equipment providing safe operation for digested sewage sludge treatment plants.

P.F.T. PACIFIC FLUSH TANK CO.
4241 RAVENSWOOD AVE., CHICAGO
NEW YORK • CHARLOTTE, N. C.
SAN FRANCISCO • LOS ANGELES

engineering features in terms of operating advantages to drive users. These advantages are covered in separate chapters on Delivered Horsepower, Drive Durability, Adaptability to Fluctuating Production Schedules, Savings in Man-Hours and Shop Space, and Economy of Installation and Maintenance.

This booklet may be obtained by request from the national headquarters of the Multiple V-Belt Drive Association, 22 West Monroe St., Chicago 3, Ill.

Clamshell Buckets

Surprising as it may seem to many, there are a number of water and sewage plants which use clam shell buckets for grit removal, ash handling, etc. Perhaps some of them if not others will be interested in a recent bulletin entitled **Johnson All-Welded Clamshell Bucket** which shows, in eight pages, 29 photographs and drawings, the various design advantages made possible by the all-welded construction of this bucket. There are three types of buckets available — general purpose, wide rehandling, and heavy duty digging, in sizes from ⅜ yards to 2½ yards.

If you are interested in a clamshell bucket, write to J. H. Heintz, Sales Manager, C. S. Johnson Co., Champaign, Ill.

Pittsburgh-Empire Water Journal

Six times a year, a very attractive magazine comes across our desk. It is filled with articles of interest on the subject of water treatment and supply, as well as interesting information on the Pittsburgh Equitable Meter Div. of the Rockwell Mfg. Co., which issues the **Pittsburgh-Empire Water Journal.** In the May-June issue is an item on the Largest Artesian Well in the World, the well near Roswell, N. Mex., in the Pecos Valley, a well that flows at the rate of 9100 gpm.; that's more than 13 million gallons per day. There is also an article on the softening of the hard water at La Grange, Ill. Water that has 890 ppm. of hardness is really hard. And then there's the story of the Pittsburgh water meter that has been in service for more than 25 years and still measured fairly accurately (100.5 per cent at 1/16 orifice, and 104 per cent at full opening). This particular issue seemed to deal in superlatives, more or less.

PULSAFEEDER

CHEMICAL PROPORTIONING PUMP

* For hypochlorination, ammoniation, and continuous chemical feeding
* Hydraulically-balanced diaphragm head... isolates chemical solutions
* Continuously adjustable while in operation
* Sealed-in lubrication... long life... low maintenance
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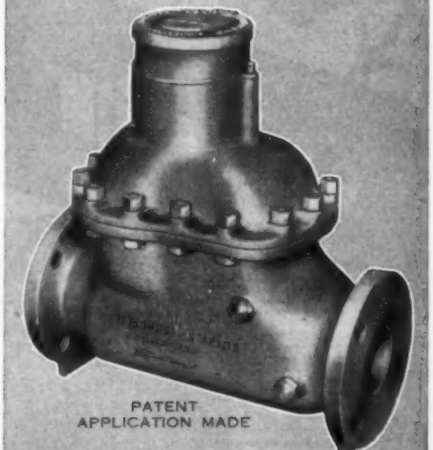

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The Chicago Metal Hose Corp. has announced the publication of a 12-page booklet entitled **C.M.H. Stainless Steel Bellows.** The booklet contains diagrammatical cross section views and information concerning the use of these bellows as equalizers, compensators, expansion joints, flexible connectors, for flow control, vapor and steam traps, thermostatic instruments, electrical controls and many other industrial applications. The booklet also contains specification charts and other data of interest to engineers, as well as a page of terminology applied to bellows.

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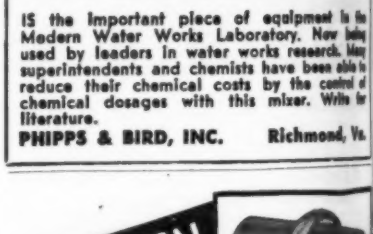

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In Book No. 21 issued by Robbins & Myers, Inc., Springfield, Ohio, **The Astonishing R&M Moyno Pump** is shown and described. This is the pump designed by René J. L. Moineau, a French engineer, and the catalog not only lists the various advantages of this type of pump for many uses, but also shows diagrammatically how this pump operates.

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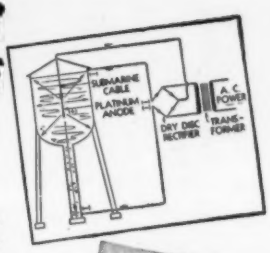

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Index TO ADVERTISERS

Albright & Friel, Inc. 128
Alvord, Burdick & Howson 128
*American Brass Co. 4
American Concrete Pipe Ass'n 10
*American Radiator & Standard Sanitary 111
American Well Works 13
Armco Drainage & Metal Products, Inc. 12
*Anthracite Equipment Co. 113
*Atlas Mineral Products Co. of Pa., The 126

Badger Meter Mfg. Co. 9
*Bailey Meter Co. 108
Baker, Jr., Michael 128
Barrett, Haentjens & Company 111
Belco Industrial Equip. Division 120
Betz, W. H. & L. D. 128
Black & Veatch 128
Bogert-Childs 128
Briggs Bitumen Co., W. A. 101
Buck, Seifert & Jost 128
*Builders Iron Foundry 27
*Builders-Providence, Inc. 27
Burns & McDonnell 128

Camp, Thos. R. 128
Carborundum Co. 51
Carson-Cadillac Co. 126
Cast Iron Pipe Research Assn. 46
Cement Gun Co. 119
Central Foundry Company 123
Centriline Corporation 17
Chapman Valve Mfg. Co. ..... Second Cover
Chemical Feeders Div. 121
Chester Engineers, The 128
*Chicago Bridge & Iron Co. 7
*Chicago Pump Co. 3
Clark Controller Company 11
Climax Engr. Co. 31
Cole Manufacturing Company, R. D. 40
Collins Engineering Co. 128
Cooper-Bessemer Corporation 14

Dean & Co., Payne 127
De Laval Steam Turbine Co. 43
DeLeuw, Cather & Co. 128
Deming Company, The 30
Diamond Alkal Co. 47
Dorr Company, Inc., The ..... Third Cover
Dresser Industries, Inc. 23
Dresser Mfg. Division 41

Eddy Valve Co. 103
Edson Corp., The 113
Electro Rust-Proofing Corp. 123

Fairbanks-Morse 24
Fay, Spofford & Thorndike 128
Fisher Research Laboratory 124
*Flexible Sewer Rod Equipment Co. 16
*Flexible Underground Pipe Cleaning Co. 16
Ford Meter Box Co. 120
Fulton, Edw. A. 128

Gannett, Fleming, Cordy & Carpenter Inc. 128
Gardner-Denver 26
General Chemical Co. 37
Gilbert Associates, Inc. 128
Glace, I. M. 128
Glauber Brass Mfg. Co. 112
Goff, Wm. A. 128
*Golden-Anderson Valve Spec. Co. 118
Gorman-Rupp Co. 28
Greeley & Hansen 128

Havens & Emerson 128
Hayden, Harding & Buchanan 128
Haydock, Chas. 129
Hayman & Co., Michael 124
Hays Mfg. Co. 110
Hellige, Inc. 118
Hydranger Corp., Ltd. 122
Hydraulic Development Corp. 33

Industrial Chemical Sales 39
Inertol Co. 127
*Infilco, Inc. 22
Innis, Speiden & Company 116

Johnston & Jennings Co., The 127
Johns-Manville 20-21-99
Jones & Henry 129
Jones Co., John Wiley 124
Josam Mfg. Co. 122

Knowles, Inc., Morris 129

Lapp Insulator Co. 125
Layne & Bowler, Inc. 130
Leadite Co., The 125
*Leopold Co., Inc., F. B. 127
Link-Belt Company 6
Liquid Conditioning Corp. 6
Lock Joint Pipe Co. 6
Lozier, Inc., Wm. S. 9
Ludlow Valve Mfg. Company 2

M. and H. Valve & Fittings Co. 100
Mathews Hydrants 100
Mathieson Alkali Wks., Inc. 100
Metcalf & Eddy 15
Meter Specialty Co. 129
Moore & Owen 15
Morris Machine Wks. 129
Morse Boulger Destructor Co. 104
Mueller Company 121
Murray Laboratory 14
..... 129

National Clay Pipe Mfrs., Inc. 54
*National Water Main Cleaning Co. 129
Neptune Meter Co. 99
*Northrop & Co., Inc. 99
Nussbaumer & Clarke, Inc. 129

*Omega Machine Co. 83
(Division of Builders Iron Fdry.)

*Pacific Flush Tank Co. 135
Parsons Brinckerhoff, Hogan & Macdonald 129
Payne Dean Co. 127
Peerless Pump Division 97
(Food Machinery Corp.)
*Pennsylvania Salt Mfg. Co. 1
Permutit Company, The 135
Philadelphia Quartz Company 102
Phipps & Bird, Inc. 128
Pirnie, Malcolm 129
Pitometer Co., The 129
Pittsburgh Equitable Meter Co. 125
*Pittsburgh-Des Moines Steel Co. 8
*Pittsburgh Plate Glass Co. (Columbia Chemical Div.) 35
*Proportioneers, Inc. 56

Regester, Robt. T. 129
*Riddick, Thomas M. 129
Ridge Tool Co. 36
Robert & Co. 129
Robert Filter Mfg. Co. 107
Rockwell Mfg. Co. 125
Rodney Hunt Mach. Co. 129
*Ross Valve Mfg. Co. 121
Rossiter, Edgar A. 129
R. S. Products Corporation 52
Russell & Axon 129
Rusta Restor, Div. of Johnston & Jennings Co. 127

Sanequipment Engineering 124
*Simplex Valve & Meter Co. 101
Sirrine & Co., J. E. 129
Smith & Associates, Benj. L. 129
Smith Company, S. Morgan 50
Smith Mfg. Co., The A. P. 45
Sparling, R. W. 129
Stacey Bros. Gas Constr. Co. 117
Stanley Engineering Co. 129
Stewart, W. H. 100
Streander, Philip B. 129
*Stuart Brumley Co. 126

*Tennessee Corp. 112
Thomson Meter Co. 53

U. S. Pipe & Fdry. Co. 61

*Vapor Recovery Systems Co. 57
Victaulic Co. of America 105
Virginia Smelting Co. 106
Vogt Bros. Mfg. Co. 126
Vogt Manufacturing Co. 126

Wailes Dove-Hermiston Corp. 44
Walker Process Equipment, Inc. 114
*Wallace & Tiernan Co., Inc. ..... Back Cover
War Assets Administration 49
Warren Foundry & Pipe Corp. 134
Westcott & Mapes, Inc. 129
Westinghouse Electric Corp. 18-19
Weston, L. A. 129
Weston & Sampson 129
Whitman & Howard 129
Whitman, Requardt & Associates 129
Wood Co., R. D. 100
Worthington-Gamon Meter Company 58

Zeolite Chemical Co. 115

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Chicago Southwest **AGAIN** *selects*

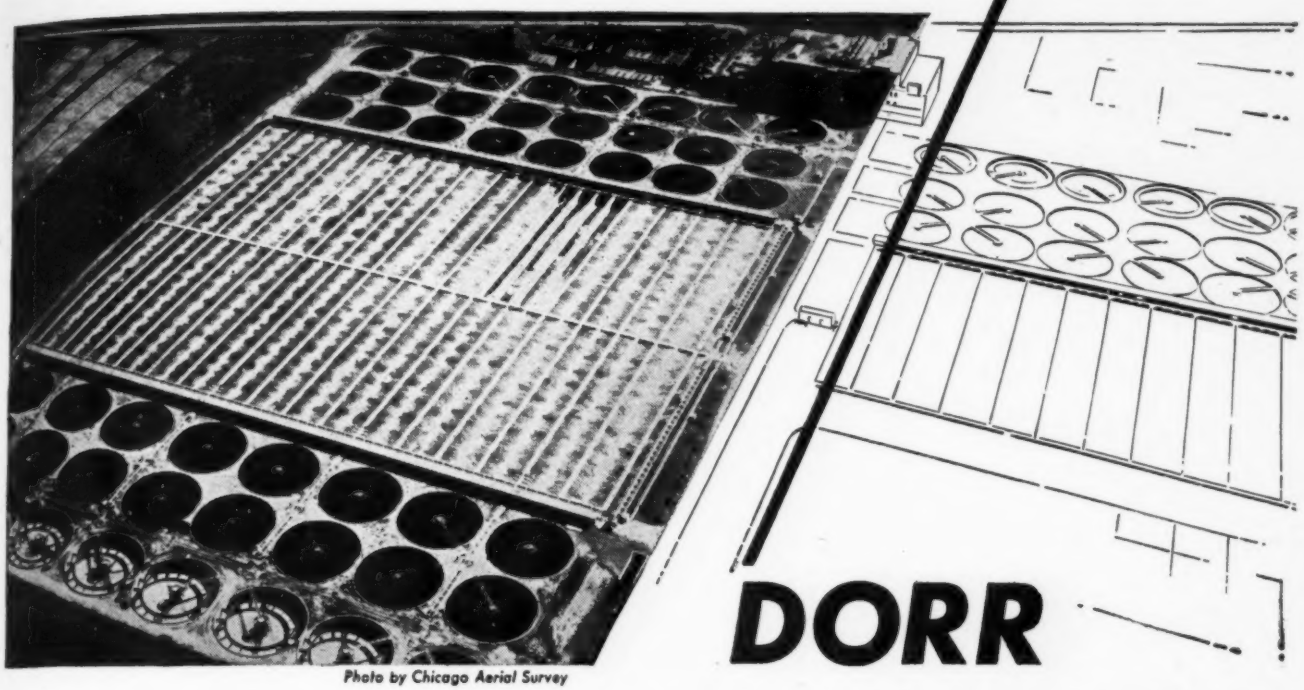

Photo by Chicago Aerial Survey

Photo shows 48 Dorr Clarifiers and aeration tanks of existing West-Southwest plant. Drawing illustrates layout of new aeration tanks and 24 additional Dorr Clarifiers.

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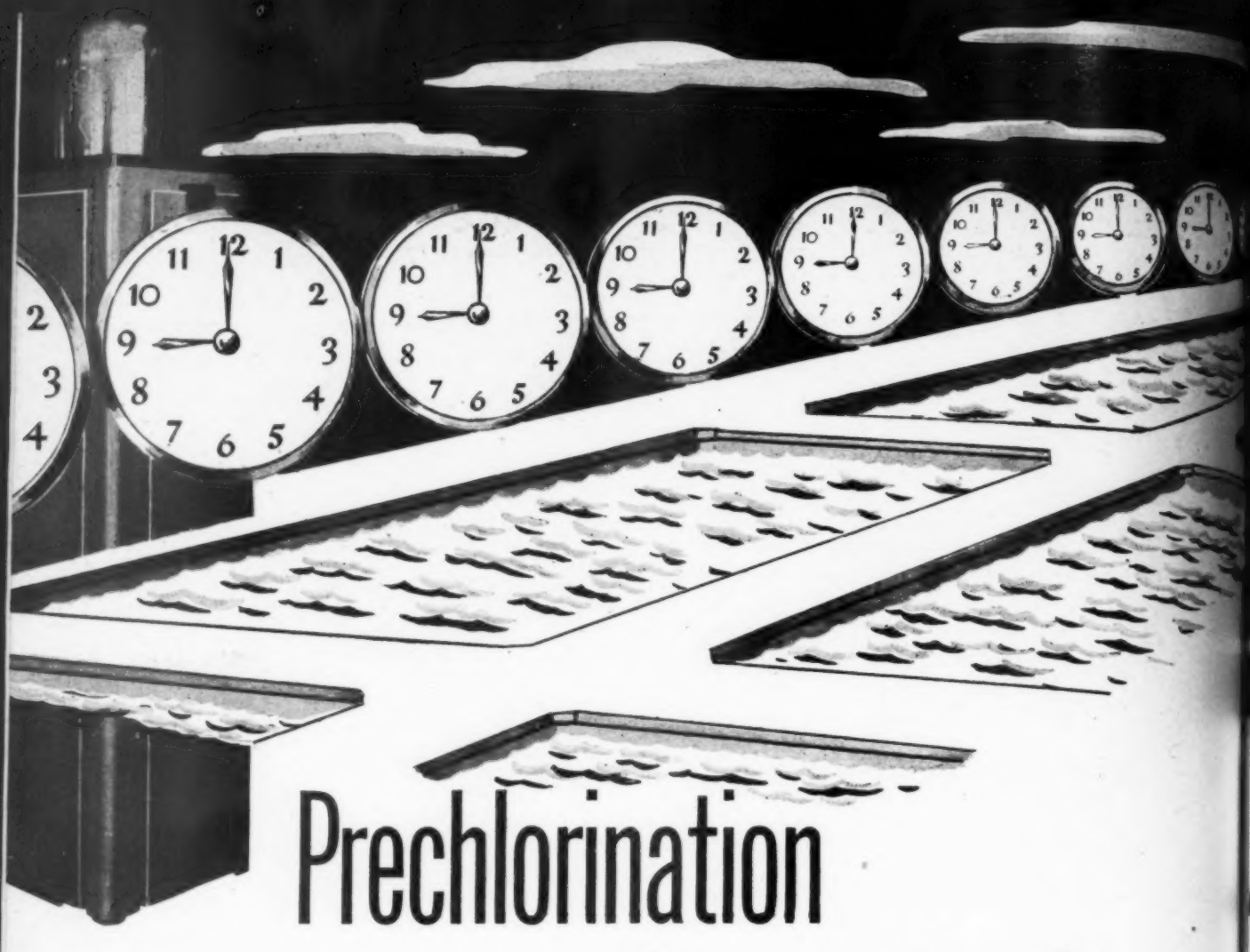

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